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GREEN PIT VIPER (*Trimeresurus gramineus*)
(Taking lever-like action of neck before attack)

INDIA — THE LAND AND PEOPLE

SNAKES OF INDIA

P. J. DEORAS

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FOREWORD

This is the third book in the Series that the National Book Trust has planned on "India — the Land and People".

The origin of the Series is the result of a discussion that I had with the late Prime Minister, Pandit Jawaharlal Nehru. When I first put the idea before him, he not only heartily approved it but gave many suggestions for making it more complete and attractive. It was his opinion that such a Series of books on India will form a permanent library of knowledge on every aspect of this country and is sure to make constructive contribution for national advancement in knowledge and education.

The Series proposes to cover every aspect of the country and will deal with its geography, geology, botany, zoology, agriculture, anthropology, culture, language etc. Its ultimate aim is to create a kind of comprehensive library of books on India. We have endeavoured to have the books written by acknowledged authorities on various subjects and in a scientific way. Every effort is being made to see that they are easily understandable by the ordinary educated reader. The factual knowledge regarding the various subjects concerning India would be available to any ordinary reader who is not a specialist and who would like to have a knowledge of the subject in a relatively simple language.

We have been fortunate in getting the guidance of leading experts and scientists in various fields for this Project. In fact without their active co-operation it would not have been possible to plan the Series. We are thankful to our Board of Honorary Editors who are eminent specialists and leaders in their field for helping us in producing these volumes for the benefit of the ordinary reader.

One of the objects of the Series is to make it available in as many Indian languages as practically possible. The work of translating them in various languages will be taken up as soon as the original books are ready. In fact a few volumes might be originally written in some of the languages.

We have received full support from the Ministry of Education of the Government of India and the State Governments. They are lending their help in many ways not the least by permitting scientists working under them to write for the Series. I would like to take this opportunity of thanking them. Without their help it would not have been possible to undertake this enterprise of national utility.

I am very grateful to my colleague, Professor M. S. Thacker, Member of the Planning Commission, for agreeing to be co-Chief Editor. His enthusiastic collaboration has greatly helped in planning the Series successfully.

NEW DELHI
March 8, 1965

B. V. KESKAR

PREFACE

SNAKES have formed an object of awe and curiosity in all lands. In India they have been associated with mysticism, apart from being objects of fear. There have been writings about snakes in old Indian literature. In these writings the allusion is given primarily to the hooded snake, the Cobra. There are records in the Ayurveda which pertain to snake venom, particularly the Cobra venom. Some of this literature has tried to give a rough knowledge about snakes, the effect of the venom, the antidotes and the probable uses of the poison.

In modern times a number of articles on snakes have appeared in the beginning of this century, particularly in the records of the Bombay Natural History Society. Col. Wall, Dr. Cazaly and Dr. Boulenger were probably the first writers to give an account of Indian snakes in a book form. These books form an important landmark on this topic. The most authoritative book on Indian snakes was written by Dr. Smith in the Fauna of British India series in 1943, and to this day this volume forms the main plank of classification and details about Indian snakes.

A number of scientific workers particularly Dr. B. C. Mahendra and Mr. McCann have been working on the different aspects of snake structure and life in India. Col. Gharpure in his book on snakes of India, Burma and Pakistan has tried to collate in a short volume the different aspects of Indian snake life. Apart from this, for a layman, a medical practitioner and a student, hardly any book is available whereby he could satisfy his curiosity about snakes, without going into details about the classification and other scientific aspects.

This book is an attempt to create an understanding about snakes. It is not a scientific treatise for classification. The readers are requested to refer to Dr. Malcolm Smith's Fauna of British India for details of classification and identification of Indian snakes. This book of Dr. Smith has been my source, and I have drawn extensively from its pages to present a simple

pattern about a few snakes in the Indian Union only. In the third chapter I have drawn extensively from various sources along with the personal observations and data from the work carried out on snakes for the last decade or so. Dr. Klauber had very graciously gone through the booklet, *Snakes and How to Know Them*, published by the Director of Publicity, Government of Bombay in 1959. It was during a meeting with him at San Diego and at his suggestions that a number of details were recorded of snake life in India. Dr. Klauber's monumental book, *Rattlesnakes* is an inexhaustible source of general information on a number of snakes and it has been a great source of inspiration and guide to me in writing the present book.

The present booklet therefore is only an attempt by me to thread these pearls of information, so that the reader in general gets to know snakes, nay gets to appreciate a snake as an integral part of nature without the fear, mysticism and fearsome folklore about them. The cobra, for example, is our national heritage and a symbol of Indian culture through the ages. The book contains a description of snakes in India, treatment of snake bites, hints to students, and in the last chapter are given simple keys to classify them into families and know some general details about some important non-poisonous and poisonous snakes of the Indian Union. I have added many photographs to make the book interesting.

The credit for this attempt goes to Dr. B. V. Keskar, without whose persuasion and encouragement this book would have never seen the light of the day. I express my sincere thanks to him.

In the preparation of the material and pictures for this booklet Mr. Vad, and Mr. Chaturvedi, my colleagues were always greatly helpful. Mr. Karnikar obliged me by assisting in taking pictures at Sanchi. Shri Sant Panchlegaonkar very kindly loaned the block showing a snake with the late Pandit Nehru. Shri Mohan Paralkar kindly helped me in executing the realistic line drawings inserted in this book. Messrs. Kalanidhi of Dadar promptly executed the photographic work. Shri Naik very kindly helped me in the initial stages and Dr. K. N. Vaidya went through the proofs. The Times of India Press has rendered valuable ungrudging

assistance in the printing of this book. To all these I owe a debt of gratitude.

Lastly, whatever is achieved in this book is largely due to my association and work with the Haffkine Institute. I will ever remain thankful to this renowned centre of scientific learning and also to the Government of Maharashtra for its permission.

Bombay
February 1965

P. J. DEORAS

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Chapter I

SNAKES AND THEIR IMPORTANCE

Snakes are found all over the world, excepting the Arctic, New Zealand and Ireland. It is estimated that there are about 2,500 species of snakes in the world and they predominate in the warm climate and lush regions of the tropics. About 216 species of snakes are found in India, of which only about 52 species are poisonous.[1] The exact number of persons bitten by snakes in India is not known though it has been estimated that about 2,00,000 persons are annually bitten by snakes and about 15,000 succumb every year to snake-bites.[2] That would make a death rate of about 0·0041 per cent only throughout India.[3] The Director of Public Health in Bombay has recorded that during a period of five years (1954–58) deaths due to snake-bites in the State were 1,237, 1,327, 1,549, 1,788 and 1,581 respectively. This will come to 0·0031 per cent death rate only.[4] These figures relate to loss of human lives. There is no data available of losses to livestock and other domestic animals.

The intensity of the distribution of some poisonous snakes and the loss to human life and livestock is difficult to calculate. Here and there interesting references occur, giving a glimpse of what such loss could have been. In the issue of the *Times of India* (May 1, 1863) it is quoted that the losses are incredible. Mr. Vad quotes[5] old records to show that in the District of Ratnagiri in Maharashtra State as many as 2,79,507 snakes (Echis carinatus) were destroyed from 1875 to 1877 and a reward of Rs. 8,774 was paid for their destruction. But no regular records of other destruction of snakes or loss of human lives have been kept.

[1] Smith (1943).
[2] Swaroop and Grab (1954).
[3] This is according to 1951 census when population was 36,10,99,663.
[4] This is according to the census of 1951 for the State of Bombay.
[5] Vad (1959).

Importance of Rodent Control

It is not realised that while the farmer is busy ploughing his fields during rains, it is the snakes who mainly control the rats. These rats do more material damage to food and health in our country than snakes. Dr. Kunhardt has estimated in 1919 that the damage caused by rats to the country in 20 years was about, Rs. 1,241 crores and that the probable "population of rats in India may be 8,000 million".

As compared to the damage caused by other diseases and animals death inflicted by snakes or snake-bites is very much less. For example the total number of deaths due to plague in India from 1898 to 1948 works out at an average of 2,47,015 per year.[1] In Bombay State alone, it is estimated that 20,000 persons were admitted to hospitals per year for rat bite.[2] On the other hand only four cases of snake-bites were admitted to hospitals in Bombay, none of which was fatal in 1958.

In the new emphasis on agricultural development and production, the problem of rat control is essential and it is here that the role of snakes shows its importance. Technical observation shows that snakes prefer rodents like rats as food.[3] The vipers brought to research institutes like Haffkine are often seen vomitting a rat or two. The economic value of rattle snakes has been realised in America by reason of their destruction of small animals like rabbits, squirrels and gophers.[4] These would otherwise have caused great destruction to agricultural fields and grazing areas. In fact many specialists caution that before any methods of rattle or other control are adopted except where safety of human life is paramount, consideration should be given to the economic aspect to find out whether depredations by rodents on agriculture are not greater than danger from the snakes themselves.[5]

Many people in India by custom avoid killing a snake, particularly a cobra. In fact in Kerala in many houses, a part of the

[1] Pollitzer (1954).
[2] Relates to year 1958.
[3] In the report of the Indian Council of Medical Research (1953).
[4] Klauber (1958).
[5] Klauber, *ibid.*

compound is set apart for snake worship where the snake is supposed to come and take the offerings. Possibly the idea seems to have originated from the belief that destruction of rodents by snakes prevents damage to property, thus preserving and adding to Lakshmi or wealth. Sometimes gardeners ask for snakes for their gardens to keep rats down.

Live Snakes

There is no particular market in India for live snakes though scientific institutions, like Haffkine purchase some. Some snakes are exported outside for zoos, exhibitions and shows. In some places in foreign countries because of the rarity of snakes, some showmen make money by exhibiting them and even showing the extractions of their poison for the payment of a fee.

In India snakes being very common, this kind of exhibition does not attract people. Snake charmers do collect snakes, particularly cobras to show the spread of the hood which it undulates at the sound of the flute. Many of them make a regular living by such performances. During the festival of *Nag Panchami*, a large number of cobras are taken from one house to another by professional snake charmers for being worshipped. These professionals earn fairly for this kind of exhibition and worship and apart from some cash, get clothing, food-grains, fruits and milk. However, few people realise that the cobra thus displayed either has its fangs pulled out or the fang holes are plugged. In some cases the salivary glands are also removed or the mouth stitched up so that it cannot bite.

Snakes as Food

During the last war, "chindwin" expedition survived on python soup. Snakes, more especially pythons, are eaten as food in China and Burma. Some people in these areas consider it a delicacy. In fact now, even in America and certain Western countries, python steak is served as a special delicacy in many restaurants. Many wild tribes in Madhya Pradesh and NEFA areas also eat snakes. In certain Chinese areas even the gall-bladder is used for making wine and medicinal preparations. Some authorities consider that

rattle snake meat can rank with other flesh for palatability, and many consider the meat definitely appetising.[1] While frogs have been put for sale in India as food, snakes are yet to come. They are not yet accepted as a palatable food by most of the Indian community.

A rattle snake normally lays about 70 eggs. These are slightly bigger than the eggs of fowl and they have a softer covering and blunt ends. It has been reported that people in the wilder tribal areas eat snake eggs and like it but definite information is not available about it.

Snake Fat

The use of snake fat for medicinal purposes is prevalent though not very common. Some Ayurvedic doctors try it for certain medicinal purposes. Experiments with this fat are being carried on for medicinal use as a substitute for other drugs. However, the use of snake oil has been practised from ancient times and was quite widespread. It was considered a well established remedy long before the rattle snake brought it to the attention of the Europeans and Americans.

Viper snake's oil was commonly recommended for some medicinal uses in India. Later in Europe rattle snake oil was substituted for it and was more favoured.[2]

Among the many uses of the oil are "to absorb tumours or swellings", "for relief of frozen limbs", "for bruises, aches and sprains". Some authorities have however doubts about the real utility of the oil. It appears necessary for this aspect to be further experimented and verified. However, Dr. Klauber who doubted some of the supposed virtues himself tried it as a pain reliever.

Snake Skin

Snake skins are in demand for making many things like scarfs, belts, shoes and handbags. The skins are more in demand outside

[1] Klauber (1958, p. 1022).
[2] Klauber, *ibid.*

India and are not so much favoured here.[1] On the other hand in India the cast-away exuvia (skin) of snakes, which is cast regularly every few months, is in demand for various medicinal purposes. It is used in all parts of India though no systematic effort has been made to see whether its use for various ailments is really effective. In Western countries the products of snake skins are quite popular and the uses to which it is put are varied like belts, wallets, purses, handbags, comb-cases, cigarette cases and tobacco pouches. Even articles of sport such as sports jackets, caps, neck-ties are sometimes made of snake skins. Snake-skin covered shoes are considered attractive and are in demand. Sometimes lamp-shades, book-covers, knife-covers are also made from snake skins. At the Institute Butantan in Sao Paulo, Brazil, the library books are bound in snake skin.

Snake Venom

Antivenin

In India snake venom is in demand primarily for the manufacture of antivenin. This is mainly manufactured at present at the Haffkine Institute, Bombay and at Central Research Institute at Kasauli.[2]

The use of snake venom in relieving pain and certain other muscular disabilities is becoming more common. Experiments are taking place regarding its use in various ways. The injection of cobra venom solution has given relief from pain in a large number of patients who are suffering from meural leprosy.[3] The use of cobra venom is also being more and more recommended in chronic pains of nervous and muscular origin, arthritis and in inoperable

[1] According to Klauber (p. 1025) before World War II about 45 lakhs worth of reptile skins were shipped annually from India to Netherlands, East Indies and Western Countries.

[2] At present venom costs in India from about Rs. 120 per gram for cobra to Rs. 250 per gram for krait and echis snake. In the Five Year Plan the requirement of this particular venom for India has been stipulated as 465 grams per year.

[3] Chopra and Chowhan (1940). They mention that "cobra venom plays a definite role in relieving pain of an indefinite nature in a large number of patients".

malignant diseases. Its solutions have even been recommended in the treatment of epilepsy.[1]

American medical experiments show that cobra venom solution is useful in intractable pain due to cancer, neuritis, arthralgia, neuralgia, migraine and nerve leprosy. The consensus of medical opinion there appears to be favourable about the therapeutic uses of cobra venom.[2] Toxicity of such preparations is not great and the chief point to be kept in mind is that dosage is determined for each patient separately. The main advantage of cobra venom therapy appears to be that it is not depressing for higher centres of the brain. It can also be substituted gradually for opium in cases of narcotic addiction to that drug.

The venom of Russell's viper can be used as a haemostatic agent on account of its coagulating principle. In cases of haemophilia and haemorrhages from other causes, graded intramuscular injections of this venom have been used with encouraging results in haemorrhages from the uterus and the retina.[3] Its solution is frequently used by dentists to stop excessive bleeding. It is also used in a dilution as an intramuscular dose for the arrest of internal bleeding. It has been included in a standardised medicine against haemophilia.

In the homeopathic system of medicine, certain diseases like epilepsy, asthma, neuralgia, neuritis, lumbago, sciatica, tics, coccygodynia, laryngitis, pleurisy, debility, nerve exhaustion and insomnia are considered to be curable by the venom of rattle snake.[4] Even Krait venom is sometimes used for this purpose.

In the Ayurvedic system of medicine, cobra venom is often utilised in preparing certain *Rasas* considered to be a medicine for T.B. The use of different parts of the body of the cobra for other medicinal purposes is mentioned in the Indian system of medicine.[5]

[1] *The Journal of American Medical Association*, volume 115 of 1940, page 1196.

[2] Ibid. Volume 138 of 1948, page 396. It is recommended here for chronic pain and advanced cases of cancer also.

[3] Pradhan and Patwardhan (1941). Fullerton has recommended the venom of Russell's viper for prothrombin time estimation.

[4] Klauber (1956, p. 794).

[5] Chopra and Chowhan (1932).

Venoms of other snakes had also been regarded as of great medicinal value in India though it is the venom of the cobra which is principally used.

There is popular belief in the medicinal utility and properties of the flesh as well as skin of certain snakes in most Eastern countries. The dried and powdered flesh of 'Tamool' (an inoffensive hill snake) and the Malayan 'Pamboo' have been popularly considered in that country as a remedy against leprosy. The exuvia of snakes powdered and mixed with oil of Dalbergia arborea, when applied outwardly, is considered to be of value in epilepsy. In the Unani system of medicine, the blood of snakes is also used in the treatment of leucoderma. In many parts of North India, a preparation of arsenic and dead cobra is applied externally for leucoderma and syphilitic rashes. The venom of snake also mixed in arsenic, opium and musk is sometimes used as a drug by some addicts and many considered it as a tonic. It is also used as an aphrodisiac and also prophylactic against some diseases. In popular belief, it is used as a hepatic stimulant in cholera collapse.

Venoms of other snakes used are those of Bothrops lanceolatus, Elaps, Apis melliffica and Arachnids.

Enzymes

Venoms are a good source of enzymes. Neurotoxin has been separated from crude cobra venom.[1] This caused the augmentation of the heart beat in toad's heart. Neurotoxin also paralyses the respiratory movements. Haemolysin which had been isolated from venom produces augmentation or depression in heart beats without causing cardiac failure. Cholinestrase isolated from the venom in high concentration slightly stimulates the heart of a toad but has practically little effect on blood pressure or on respiration in other animals like rabbits.

A number of other enzymes have been isolated from snake venom for important biochemical research. Some of them are hyaluronidase,

Note: In homeopathy, the venom of the snake Lachesis is indicated in abscesses, carbuncles, erysipelas, apoplexy, paralysis, meningitis, mental diseases, asthma, tuberculosis, syphilis, chorea, flushes, skin diseases and the diseases of the teeth. Cobra venom is indicated in diphtheria and cancerous growth.

[1] Sarkar, Maitra and Ghosh (1942).

ribonuclease, ophio-oxidase, phosphodiestrase, nucleotidase and lecithinase. They have already found their way in the many research projects.

It will be clear that snakes form an important and integral part in the natural structure of things in this world. No doubt there are many poisonous snakes but fatality from snake-bites is not so great as it is thought about in public nor are the majority of snakes poisonous. Moreover, there is a great deal of exaggerated fear of snake and its poison. As already indicated, the majority of snakes are non-poisonous but having no means of identifying them, bite by any snake generally so frightens the bitten patient that he is already half dead with fear. The psychological fear of snake-bite can be removed by some method by which poisonous and non-poisonous snakes can be distinctly identified. The author has seen cases where even supposed bites of snakes have already produced dangerous symptoms in patients which ultimately proved to be without foundation.[1]

Prevention and Control

If we take an overall view, it will be found that though poisonous snakes are harmful, snakes in general have many beneficial activities to perform and a proper understanding of these creatures and their venom can be very useful to humanity and might in many ways help to compensate the losses caused by the loss of human lives by snake-bites. Sometimes people make proposals for extermination

[1] Two recent cases can be related here. A lady sitting on the lawn of a maternity hospital in Bombay felt that something had bit her in the leg. On looking around a small creature was found which was taken for a snake. The lady immediately began to feel that her leg is being paralysed and psychologically she had all the symptoms of snake poison. On examination it was found that the creature was only a fat earth-worm. The probable cause of the bite might have been ants which are common on the lawn.

Another case which was brought to the author's notice recently showed that a lady was bitten by some creature in the bath-room. She suspected a snake and immediately began to complain of pain and burning sensation in the arm and became quite pale and nearly senseless. After examination, it was found that she was bitten by a cockroach on the finger tip. Needless to say that the lady recovered very quickly.

Fig. 1. The fight between a cobra and a mongoose. The latter normally wins the fight by sheer agility. It kills the cobra by burying its incisor-teeth behind the head of the snake and severing the vertebral column from the cranium. During the fight the mongoose is seen rushing to dig grass roots, apparently to sharpen the teeth.

Fig. 2. Cobra snake being " charmed " by a gourd; a sight quite common in India.

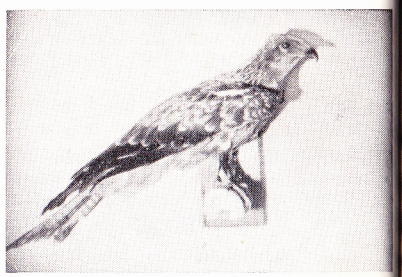

Fig. 3. Falcon bird.

Fig. 4. *Kaliya mardan.* The subjugation of the Naga " Kaliya " by Lord Krishna.

Fig. 5. *Shesh-shai.* Lord Vishnu resting on a many headed cobra snake that lies in an ocean.

Fig. 6. Hooded serpent images under a Ficus tree in Mysore State. Note the coiled snakes and also the female face with coils below.

Fig. 7. Naga raja with seven-headed cobra head-gear. His consorts have one-headed cobra head-gear. Cave No. 19 at Ajanta.

(*Photo from Mukul Dey*).

Fig. 8. Sanchi. (Main stupa) *Torana* on the Western gate. Naga raja with five-hooded cobra as a head-gear while his consorts have a single-hooded cobra head-gear. This last can clearly be seen in profile on the right-hand side.

of snakes. First of all it is difficult to exterminate a species excepting in a very small area by human agency. Experiments made on birds and certain other insects have shown that sometimes such disturbance of the natural process creates other problems for man. Of course, snakes like extinct reptiles might disappear by process of evolution. The destruction of forests and expansion of urbanisation has already had the effect of bringing snakes out of their hiding and diminishing their number. We must remember that the diminishing or disappearance of snakes might lead to a rapid increase in the population of rodents like rats which might become a menace to agriculture.

Many normal precautions can be taken to prevent being bitten by snakes. It is first of all desirable for persons going about in areas where snakes possibly abound, to cover their legs properly with shoes. Keeping rats and frogs away from our houses also helps in keeping snakes out because rats and frogs attract snakes as they are their natural food. The keeping of peacocks in agricultural areas, the taming of mongoose (*Figure 1*) and sometimes wherever possible attempts at keeping the bigger owls, falcons (*Figure 3*) and kites in farms would to a great degree help in the reduction of snakes because peacocks attack and eat snakes and mongoose are natural enemies of snakes. So also are birds like falcons and owls. One method of keeping rats away from houses would be to spray diluted carbolic acid around the houses. A concentrated solution of any insecticide or even phenyle kills a snake. Snakes can also be driven out from burrows and holes by smoke. In Rajasthan it is customary to put onion pieces in tents in the desert areas to keep snakes away, though there is no definite evidence of the utility of this practice. It is possible that the pungent smell of the onions might have some effect.

Finally, it is necessary to understand the important role of snakes in our natural and agricultural economy. If we take proper precautions and try to understand the distinction between venomous and non-venomous snakes, it will help us in utilising the majority of snake population for useful purpose for which nature has meant them.

Chapter II

SNAKES IN INDIAN CULTURE

SNAKES, and particularly Cobra, have been intimately associated with Indian folk-lore, religion and art. There are two days in the year, *Nag Panchami* and *Anant Chaturdashi* (these fall approximately in July and September) when the Naga (the cobra) is worshipped in India. The legion of this worship is still not fully known but it is from the most ancient times that this form of worship is prevalent. Of the two days, *Nag Panchami* is the more common throughout the country. There may be variations in the date and the local traditions and modes of observance but it is celebrated in most parts of India according to ancient beliefs. This testifies to the feelings of awe and veneration which the serpent evokes in the minds of the population from earliest times.

There is a folk-lore legion prevalent about how the *Nag Panchami* day for observance of Naga worship started.[1] This Naga story is

[1] Vogel (1926). The full story as related in the folk-lore is given separately here.

" Oh God: Nagas, hear. There is a city, called Manikpura (or Manipura). In it lived a Govada (Gaur) Brahmin. He was ignorant of *Nag Panchami*. And he did not know that on that day there should be no ploughing, no digging, no plucking, no burning and roasting. But he went to plough his land on that day as usual. There was a hole of Nagin (a female cobra) in one place in the field and in it were her young ones who died by striking of the plough. The Nagin who had gone out returned, and finding that all her young ones were dead, she grew enraged and set out to ascertain who it was that had killed them. Thus she came to the house of the Brahmin and seeing that blood had stuck to his plough, she decided that it was he who had killed the young ones. She, therefore, bit the Brahmin and called on the members of his household who had gone to sleep, and killed them. And in order that his whole family might become extinct, she went to bite his daughter who had been married in another village. But the daughter had painted the Nagas, and having worshipped them and given them offerings, had placed before them at night, frankincense and other fragrant things, lamps, etc. On seeing this the Nagin enjoyed the good things that had been placed there, and being pleased, said to the girl: " O daughter, thy father killed all my young ones today, while ploughing the field. After having killed all the persons in thy maternal

repeated at the time of Naga worship. It is difficult to say when this folk legion started.

The story of *Nag Panchami* festival relates that in a city in India lived a Gaur Brahmin. He was ignorant of the sacredness of the festival and in ploughing his fields on that day, he killed young ones of a female cobra by the stroke of his plough. When the mother returned to the hole and found her young ones killed, she grew very angry and went out to ascertain who had killed them. On finding that the Brahmin had killed the young ones, she killed one by one all the members of his family, excepting one daughter who was married and was staying in another village. According to the legion, when the Nagin, female cobra, went to the house of the Brahmin's daughter, she found that she was a worshipper of the Naga and was in the habit of making offerings of flowers etc. to the Nagas on *Nag Panchami* day. She was pleased by this worship and in return for the devotion of the daughter, she gave her some elixir and asked her to bring back to life her father and other members of the family. The daughter brought back to life by sprinkling this elixir upon all the dead bodies of her father and other members of the family and according to the legion from that day all women in that village and later throughout the country began to observe the *Nag Panchami* festival in that particular month of *Sravana*.

home, I had, therefore, come to thee too, but as thou didst remember me and worship me, I am pleased and, therefore, I do not bite thee."

On hearing this, the daughter said: " Thou hast killed all the persons in my maternal home; tell me some remedy by which they may come to life again ". Thereupon the Nagin said, " Do thou take this nectar and sprinkle it over their bodies and thereby they will be restored to life ". Meanwhile the people in that Brahmin village began to inquire why it was that the Brahmin had not yet arisen and opening his door found that all the persons in the house had died. Just then the daughter arrived and sprinkling upon them the nectar given by the Nagin, restored them to life. Then she told her father all that had happened and added: " Now from this day, when the month of *Sravana* cometh, thou shouldst worship the Nagas on the fifth day in the bright fortnight according to rites laid down and should place before them at night frankincense, lamps and food. And on that day thou shalt not dig, neither shalt thou kill anything on that day."

The story is repeated at the time of the festival and milk and offerings are offered to please the Nagas. The Goddess Manasa, who is worshipped in connection with the festival is identified with the sister of legendary serpent king ' Vasuki '. According to the Mahabharata, she was married to the sage Jaratkaru and was the mother of Astika. Legend has it that Astika saved Nagas from being exterminated during the serpent sacrifice performed by Janamejaya. Manasa is believed to afford protection against snake-bite and is called ' vishahari ' (poison destroyer). She is represented as a beautiful woman with golden colour, and sitting on the water-lily and covered with snakes.

Customs differ in different parts of India for worship of Naga. In Bihar, women distemper their houses and worship Shesh Nag with milk and parched grain. On *Gobar Panche*, which falls on the 5th day of the dark half of the same month, Naga is worshipped in Patna. In South Bhagalpur district it is called *Behra Panche.*

In U.P., according to the traditional custom, the head of the family takes a bath, paints on the wall of his bed-room two outlines of serpents and then gives gifts to brahmins as offerings. People generally pray to the eight Naga chiefs. Girls throw offerings into water. No work is done on the day, artisans and labourers take a holiday and worship the tools which they use. A week before the festival, a mixture of wheat, gram and pulses is prepared in water. On the morning of the festival day some grass is tied up in the form of a snake, dipped in water in which the corn mixture has been prepared and offered with money and sweets to serpents.

In Eastern Districts of U.P., it is customary for girls to let dolls float in water of a tank or river and the village boys beat the dolls with long sticks. This is explained by a legend which is based on the story of Janamejaya and the Nagas. In Mirzapur district, *Nag Devta* is worshipped by the ' kols ' on the occasion of *Nag Panchami* and the date of the fair is the 11th of the brighter half of *Sravana.* In some parts of U.P., *Nag Panchami* is celebrated in *Bhadrapad* (August–September). In some other districts, it is the 5th or the bright half of *Sravana.* In district of Garhwal, the ground is sprayed and distempered. Figures of serpents are outlined with sandalwood paste or turmeric. Parched rice is prepared and lamps are displayed

before these figures. Food and fruits are also offered both in the morning and evening. During night people listen to the stories in praise of *Naga Devta* (Naga god).

In Nepal, the festival is held on the 5th day of dark half of *Sravana.* There, the festival is held at *Changu Narain* where it is said that the image of Garuda (divine eagle) perspires regularly on that anniversary. The priest wipes the idol with a handkerchief which is sent to the King. Even a thread of that handkerchief is said to make it into an unfallible remedy against snake-bite. A ritual worship is performed at the meeting of two streams. The performer, after taking bath, offers a dish in which rice, milk, water, rice flour, flowers, ghee, spices, sandal powder and incense are placed. He prays to the Nag Raja to bless their crops and chants blessings to him also.

In Punjab on the day of *Nag Panchami* a figure is drawn in black on the house-wall. It represents the snake-God in his dwelling place and is believed to prevent the house from being infested with snakes.

Snake Legends

There are many snake legends in the ancient *puranas* (mythology) which are popularly known and recited. Some of them are given below.

The legend of Krishna and the Nag ' Kalia ' known as *Kalia Mardan* (*Figure 4*) is universally known. Kalia was polluting the water of the river Jumna with his poison and Lord Krishna, even as a child, jumped into the waters to subjugate this formidable Naga.

The legend of churning of the ocean (*Samudra-Manthan*) is well-known in which it is said that the Devas (the Gods) and the Asuras (the demons) joined hands to churn the ocean. They used the mountain Meru for churning and they utilised the coils of the great serpent Shesh Nag as a churning rope. They are said to have recovered 14 inestimable jewels by this churn.

King Janamejaya performed Snake sacrifice in which all snakes were thrown in as offerings to take revenge for the death of his father Parikshit at the hands of Takshaka.

The supreme Lord, Vishnu, is always depicted as resting on the many-hooded serpent in an ocean of milk (*Kshir-Sagar*). (*Figure 5*).

Lord Ganesh is shown with a weapon called *Naga-Bana* (snake arrow).

Lord Shiva is popularly depicted wearing a garland of deadly snake around his neck. In one of the systems of Yoga, known as the Kundalini Yoga, the supreme power Kundalini is shown as a coiled cobra which gradually ascends the spinal column.

The seal of some of the maharajas of Orissa pictures on the crest a cobra with a human face under its expanded hood and surrounded by insignia of royalty. The rajas of Chhota Nagpur claim to have derived their origin from the Naga, Pundarika. A certain section of the Kayastha community in Bengal consider that their origin is from the serpent king Vasuki.[1 & 2]

In Chamba and Kangra Valley (and Kashmir Valley also) temples are dedicated to various Nagas like Shesh Nag, Basak Nag, Takht Nag, Prittam Nag, Sabir Nag, Karkotaka Nag, Karsh Nag, Indru Nag, Santan Nag and many others who are worshipped in human form. Over each, however, there is a hood of three snake-heads. In the valley of Chenab, the temples of Vasuki have a Wazir who is called Jeemut Vahan.

The famous dynasty of the Kings of Kashmir in which the famous Lalitaditya was born is considered to be descended from the Naga Karkotaka. Oldham has mentioned that in some of the Himalayan dialects, *kira* or *kiri* means a serpent. This name is found in the Rajatarangini, where it is applied to a people in or near Kashmir. The *kiras* are mentioned by Varaha Mihira and also in an English copper plate. (The name might perhaps have come from *Kirata*.)

Coiled serpents images are found all over India. In Saurashtra, every village has a serpent temple (*Sermalia*). Naga Worship is

[1] Vogel (1926, p. 17) mentions that "innumerable are the famous lords of Nagas, headed by Vasuki and beginning from Takshaka, earth-bearers resembling the sacrificial fire in their splendour (*tejas*); who increasingly cause thunder, rain and heat and by whom this earth with her oceans, mountains and continents is supported and who in their wrath might smite the whole world by their breath and sight".

[2] Oldham (1905).

very common in the South. For example in Mysore State, people keep images of coiled serpents beneath a pipal tree. The images are worshipped for getting children, wealth, rain or longevity (*Figure 6*).

In the Valley of Chenab in North India, amongst many families every male member bears the name of Vasuki who was a legendary head of the Nagas. There is a popular legend that Nagas inhabit lakes, pools and springs of water. We find mention of it in many folk tales even today. On the other hand we find it rarely mentioned of Nagas inhabiting mountains and trees in any legendary tale.

Snakes in Ancient Literature

There are numerous references to snakes and their characteristics in Sanskrit poetry and ancient literature[1].

Prayers are offered to Nagas, either for getting their goodwill or keeping snakes away. In many prayers to Gods, the name of Naga is mentioned.

In the prayer of Lord Vishnu, it is mentioned[2]:

"One who is the embodiment of
quietude and peace,

[1] "A snake drinks air yet is not weak."

(सर्पाः पिबन्ति पवनं नच दुर्बलास्ते)

[2] "Those who will remember the nine Nagas, Ananta, Vasuki, Shesha, Padmanabha, Kambala, Shankhapala, Dhritarashtra, Takshaka and Kalia, particularly in the morning time as well as in the evening, will be free from the fear of venom and be victorious all the time".

(अनन्तं वासुकिं शेषं पद्मनाभं च कंबलम्।
शंखपालं धृतराष्ट्रं तक्षकं कालियं तथा।
एतानि नव नामानि, नागानां च महात्मनाम्।
सायंकाले पठेन्नित्यं, प्रातःकाले विशेषतः।
तस्य विषभयं नास्ति सर्वत्र विजयी भवेत्।)

"One who remembers Karkotaka Naga, Nala and Damayanti, King Tiruparna and sings their praise will be absolved of the consequences of Kaliyuga age".

(कर्कोटकस्य नागस्य दमयंत्या नलस्य च,।
ऋतुपर्णस्य राजर्षेः कीर्तनं कलिनाशनम्।)

One who has subjugated and
sleeps on a many headed serpent.
One on whose navel-lotus
the Brahma stays".

शांताकारं भुजगशयनं पद्मनाभं सुरेशं ....

In the prayer to Lord Shiva in *Shivakavacham*, the following line is mentioned:

"Naga in the ear as earings,
Naga as a garland,
Naga round the head,
Naga round the body,
Thus our lord
Trimbak who has
conquered death, killed
the demon Tripur cosmic
form and with three eyes".

नागेंद्रकुंडल, नागेंद्रहार, नागेंद्रवलय, नागेंद्रचर्मधर
मृत्यंजय, त्र्यंबक, त्रिपुरांतक, विश्वरूप, विरूपाक्ष

In the *Shiva Panchakshar*, there is the following mention of the Naga:

"One who has a garland of *Nag* snakes, one who has three eyes, one who has put Bhasma on his body, one who is a great God, one who is eternal, one who is pure and dons the universe, I bow to that *Nirguna* Shiva."

नागेंद्रहाराय, त्रिलोचनाय,
भस्मांगरागाय, महेश्वराय,
नित्याय, शुद्धाय, दिगंबराय,
तस्मै नकाराय नमः शिवाय ॥

In Shivashtakam, it is mentioned:

"One who has garland of skulls, one who has snakes all over the body, one who is the Lord of Death and one who is the guardian of Lord Ganesh".

गले रुंडमालं, तनौ सर्पजालम्,
महाकालकालं, गणेशाधिपालम् ॥

In *Shivamahimna*, it is mentioned:

"One who has smeared the Bhasma of a funeral pyre, one who has digested the famous poison, one who is clad in cosmos, one who has long traces of hair, one who has fiery snake on his neck and is the Lord of a Bull".

चिताभस्मालेपो, गरलमशनं दिक्पटधरो ।
जटाधारी कंठे भुजगपतिहारी पशुपतिः ॥

In Vedic literature, there is frequent mention of snakes. In the Rig Veda, *Ahi* means snake, and Indra, Chief of Devas, defeated *Ahi* Vritrasura.

In Yajurveda and Atharwaveda, the following reference is found:

"Homage to the snakes which ever move around the earth, which are in the sky and in heaven, homage to those snakes which are in the arrows of sorcerers and of tree spirits and which lie in holes, homage to those snakes which are in the brightness of heaven, which are in the rays of the Sun, which have made their abode in the waters."[1]

In Atharwaveda, which abounds in magical spells, there are numerous references to the charms which are used to avert damage or injury by snakes. In the Ramayana, it is narrated that the Naga mother *Surasa* appears in the guise of a *Rakshasi* in order to test the strength of Hanuman during his flight to Lanka. In the last Canto, it is mentioned that Seeta, who was swallowed by mother-earth, was carried on the lap of Goddess Earth who is seated on a throne which is carried on the heads of Nagas of boundless light.

In the Mahabharata, it is mentioned that Baldev, elder brother of Krishna, was an incarnation of Shesha Naga. There is also the

[1] Oldham (1905).

legend of Arjuna marrying Ulupi, the snake nymph and the marriage of Rishi Jarat Karu with the sister of snake king Vasuki.

In the Mahavansha, it is mentioned that Sanghamitra, daughter of the Emperor Ashoka, took the form of Garuda to vanquish the magic powers of Nagas who wanted to take away the branch of the Bodhi tree which she was carrying to Ceylon.

In Buddhism, there is frequent mention of snake worship. At many places, the Lord Buddha is shown under the shade of the expanded hood of a 7-headed Naga.

In the Puranas, the legend is that the favourite haunt of the Nagas is Patala (hell). Among the various attractions of the serpent world the Naga Kanya or snake maiden is not the least seductive. It is considered that these snake maidens have the quality of arousing the passions of men and thus seducing them.

In Sanskrit classics, there is a frequent mention of the Nagas and their powers. In Kalidasa's Raghuvamsa in the 16th canto, it is related that when the King lost the magical amulet given to him by Rishi Agastya, it was supposed to have been taken by the Naga Kumuda, who lived in a pool in the river. The king shot the powerful Garuda weapon and immediately the Naga King came out with his youngest sister, the beautiful Kumudvati, who playfully had taken it. The Naga King restored the jewels and offered in marriage his sister.

Snakes in Indian Art

In the cave paintings of Ajanta, Naga kings have been depicted with an odd headed Naga (Cobra). (*Figure 7.*) In cave No. 19 at Ajanta, the Naga king is seen with a seven-headed hood and attended by his consort.

In the majority of the Indian temples, the presiding God has an umbrella shade of an odd headed Naga hood.

The central arch of the eastern torana of Sanchi Stupa, has a well-known relief representing the worship of the Bodhi tree by the animals of the forest. Amongst them there is a 5-headed Naga side by side with Garuda (eagle). On the same gateway, we have another scene of the Buddha subduing the venomous dragon in the hut of the Kashyap brothers. Here too the cobra has 5-headed hood.

There are two more reliefs which probably represent Nagaraja, sheltering the Buddha. In each case the Nagaraja is attended by the nagins, all of whom have a single headed snake at the back of their head, while the Nagaraja has a 5-headed hood. The single headed snake hood is specially noticeable in the relief on the western gate. (*Figure 8.*) It has the look of a cap or covering. It is not clear whether they mean to be taken for head-dress. The use of the cobra hood for different purposes is a significant development as indicated by art structures at Sanchi. The 5-headed snake is shown both as being subdued in one place and in another relief with other animals. On the torana on the left of the main entrance, the Nagaraja has the 5-headed hood over his head. This is noticeable also in another small relief. Though it is difficult to interpret definitely, there is a possibility that the use of the hood in this way might have become a royal insignia to be used over the head of a king.

In another Stupa at Sanchi, a complete circle indicating the Sun is shown in which a coiled hooded cobra is depicted. This is on the south-eastern torana of the Stupa. On the north-western side of the Stupa, there is again a hooded snake inside a round disc. Here two Nagins are holding garlands to the Naga. This 5-headed snake shows a bifurcated tongue. (*Figure 10.*) In Sanchi there is also a life-size statue of a Naga king with not only a snake hood but the snake coils running down his legs.

These reliefs indicate some relationship between the Sun, the many headed cobra and the use of many headed hood as a symbol of honour. Some scholars consider that the hood is a totem of Sun worship and all those who trace their geneology from the sun could use it over their heads.[1]

Snakes in Other Countries

Snake and sun worship were not confined to India alone. Greeks worshipped the sun and serpent from the earliest times. They were also worshipped by the Phoenicians and Babylonians. Traces of serpent worship are found in Syria and other parts of Asia even about the beginning of the Christian era.[2]

[1] Oldham (1909).
[2] *Ibid.*

In Egypt, the sun was worshipped and the hooded serpent (Ureus) was held sacred from the earliest times. A symbol of the hooded serpent was attached to the front of the King's head-gear. This was not merely a badge of royalty, but was also a protection for the King. Negus, the title of the King of Abyssinia, might be closely related to that of Nagi, which is used by chiefs of the Khus tribes of the Himalayas who worship serpents. In China and its neighbouring countries, the worship of the sun and the serpent appears to be an ancient form of religion. The Dragon (or Naga) still protects the empire. Shrines to Ling Wang, the Dragon King (Naga Raja) are numerous.

In Korea, people feed and worship serpents, as the guardian genii of their household. In Japan, the ritual connected with the worship of the sun and the serpent was for all particulars nearly the same as in India. In Tibet the springs, rivers and lakes are still ruled by the Naga demi-Gods. According to their belief, Lu-Naga King lived in a crystal palace in the depth of lake Palti.

In Central and Western Africa, the serpent and the tortoise, designated as the totems of the solar race, were held sacred. No important venture was undertaken without a sacrifice to the serpent. When the Spanish invaded South America, they found that snake and sun worship was universal there with the exception that the place of the hooded serpent (Naga) was taken by the native rattle-snakes (because the hooded serpent does not exist in America). The attributes to the rattlesnake were the same as those given to the Naga in India in its legendary lore.

The universal worship of the snake, particularly the Naga, has been the object of study by many modern scholars. Deane, Oldham and Dr. Boch have carefully analysed and given their interpretation of Naga worship.[1]

[1] Rev. Deane (1833) says that " the deception of the Eve by Satan, through the instrumentality of a serpent has been an object of ridicule with the profane. Snake worship is as old as sun worship. If the worship of the sun, therefore, was the first deviation from truth, the worship of the serpent was one of the first innovations of idolatry. The serpent was the most ancient of the heathen gods ".

Oldham (1905) has summarised his conclusions thus:—

In view of the ancient customs and beliefs, quoted above, and the views of the authorities that have been quoted, Naga worship and its importance in art and culture is highly significant. I have personally observed the stupas at Sanchi and there is a strong possibility that the Naga might be a totem of sun worship and the interpretation given by Dr. Boch might have some meaning that the five-headed Naga is a hand raised with fingers as in benediction. However, the matter requires to be more carefully considered and investigated.

In ancient times in India, Kings were chhatrapatis (royal persons entitled to a Chhatra, that is an umbrella, as insignia). The Naga hood appearing over a King might be a totem or symbol of sun worship or just royal insignia.

In studying the images, we find the snake many headed with human form or with a polycephalous snake hood. In literature, one sometimes finds mention of the snake with a thousand heads. Such variations only indicate an exaggeration of this symbol or totem.

The Chinese pilgrim Hiuen Tsiang relates the story of King Udayana who married a Naga princess. According to this, every

" We have seen that the worship of the sun and serpent was in time past, well nigh universal, and that it was already established among some of the most enlightened peoples of antiquity, at the earliest period of which any history has come down to us."

" We have also seen that the hooded serpent was held sacred as a totem of the people who claimed descent from the sun-god and thus came to be worshipped as a deity. The deification of some sun-worshipping countries all arose from the corruption of the earlier worship of a supreme deity who was to reside in the Sun. The Gayatri, the most sacred text of the Vedas which contains the essence of Hindu religion, is a short prayer to the sun-god, who is addressed as Savitri — the generator or creator."

" The combined worship of the sun and the serpent-god must have spread from a common centre by the migration of or communication with the people who claimed a solar descent. So universally was the Naga held sacred that it would seem to have been the earliest totem of the people who claimed descent from the sun-god. The Naga of Indian mythology and folk-lore is not really the snake in general, but the cobra raised to the rank of a divine being."

" Divine serpents are many headed. It is a characteristic of the Nagas often insisted upon in literature. In art the number of heads varies; but is always

time he was with her, a nine-headed hood of Naga came forth from her head.[1]

The serpent as such is not so much venerated as the hooded Naga (cobra). In the Udyoga Parva of Mahabharata it is mentioned that there was a Naga Raja named Asura.[2] In the Vishnu Purana, it is mentioned that one of the names of the royal family of solar race of Ayodhya was a King named *Ahi* raja. Indian folklore is full of legends relating to the rajas and warriors of the serpent race and it is possible the Indian festival of *Nag Panchami* is celebrated probably in honour of the Naga Rajas, as Gods.

It is interesting that the Naga temples in North India are not dedicated to the serpent cobra but to the Naga Raja, the ancient rulers of the race. All the Nagas like Shesh Nag, Karkotak Nag etc. are worshipped in human form with three hoods like a trident. It is possible that the Naga Kings were clever builders and built big cities. The Mayasabha in Mahabharata might be due to such great architects. According to legends, Naga Kings founded cities like Patal, Pragjyotisha, Takshila, Magadha, Mathura, Vilaspur, etc.

Snakes in India, particularly the cobra, as will be evident from the mythological and historical references that we have cited, is an important symbol in religion, mysticism, folklore and culture

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uneven; it may be three, five or seven. It can be a matter of surprise that a marked preference for the number exists. In literature too, the five headed serpent is often mentioned; a simile in the epics likes it to the human arm ending in the hand with its five fingers."

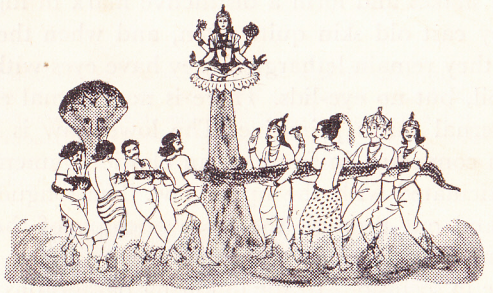
Dr. Boch (1960) has another interpretation. He says:

" That the human arm frequently occurs as a symbol of the lotus-stalk. We shall refer to this again and as the Naga fulfils the same part it follows, in accordance with the rule of identification through a concealed third that the arm is identified with the serpent's body and that also the spread out fingers are identified with the hood of Naga heads. This explains why in literature the Naga is so often compared and identified with the five fingured human hand and why, inversely, the Naga head in art not infrequently shows a remarkable resemblance to the human hand with fingers turned in like claws. The number of the Naga heads being five may be traced to the same identification with the fingers of the hand."

[1] Oldham (1909).

[2] Ibid.

throughout the country. It is possible that it was the practice and belief of those who were there in the country from time immemorial. Those who came from the far north and from outside absorbed and accepted it as part of their culture. A unity of culture thus seems to be maintained through the ages. Research on this absorbing topic will engage the attention of historians and scholars for years to come, to show that cobra is a symbol of Indian unity of culture and civilisation through the ages.



Churning of the Ocean (*Samudra Manthan*).

Chapter III

KNOWING THE SNAKES

REPTILES have been on this planet before the mammals were born. In fact they dominated much of the ferocious fauna during that period. Crocodiles, Lizards, Turtles, Tortoises, and Snakes now comprise some of these animals on this earth.

Snakes belong to the class Reptilia, and are classified under the order Ophidia.

They have an elongate body, roughly divided into head, body and a tapering region called the tail beyond the vent. There are no external appendages or limbs except for a few rudiments seen internally in *Typhlops* sp. *(Figure 12b)* and externally in *Python molurus* (*Figure 12a*). The body is covered by scales which are imbricate in primitive snakes and form a distinctive mark in highly evolved snakes. They cast old skin quite often, and when they do not do so for long, they remain lethargic. They have eyes with a round or vertical pupil, but no eye-lids. There is no external ear in snakes and the internal ear is primitive. The lower jaw is not a single bone, but is connected in front by an elastic ligament and is not properly articulated with the upper jaw. The tongue is bifid and quivers in and out through the loose opening of the lower jaw. There are modified teeth in some snakes which form fangs. They prefer to live in seclusion. In the following paragraphs we will deal with some knowledge about the snakes, their morphology and general behaviour.

Python is the longest snake and also the heaviest. It has been recorded to grow upto 25 feet and weighs as much as 300 lbs. The smallest ones would be about five inches in some of the blind snakes. Reptiles live long. The records in laboratory are 4–6 years. In nature they may live more than 25 years. There is a great variety of colour in snakes. In plain colour we get the deep brown or black cobra or sand boa, *Eryx johnii* and on the other hand we get white-albino cobra. Parrot green whip snake

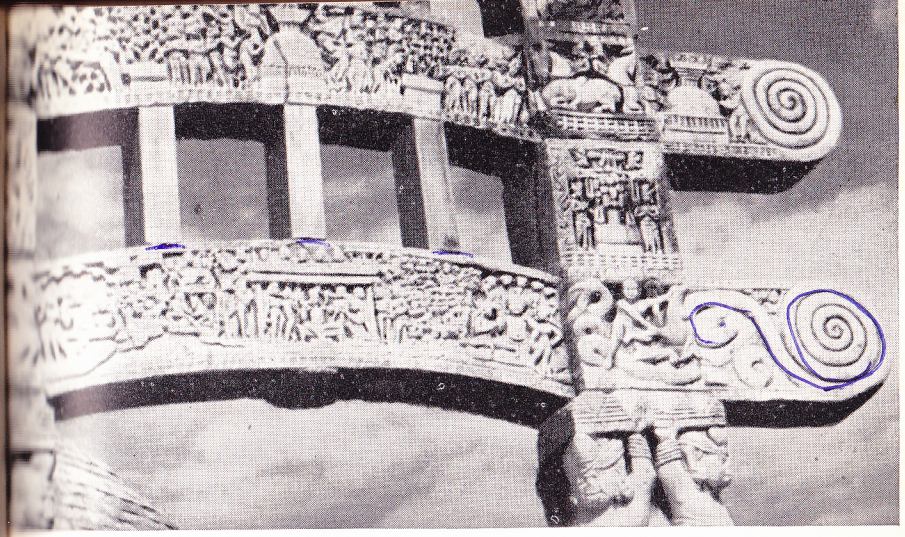


Fig. 9. Sanchi (small stupa at the entrance of the main stupa). Main *torana* lower rail, right- and left-hand corners depict a Naga raja with five-hooded cobra head-gear and his consort.

Fig. 10. Sanchi (small stupa at base and west of main stupa). Western rails of the *torana* showing a round disc representing the sun inside which is shown a five-hooded cobra with bifurcate tongue. Two female figures are standing at sides holding garlands in their hands.

Fig. 11. X-ray photograph of a two-headed king-snake — to show that it is only a monstrosity and that there is nothing fearsome about this freak.

(*Photo: San Diego Zoo*)

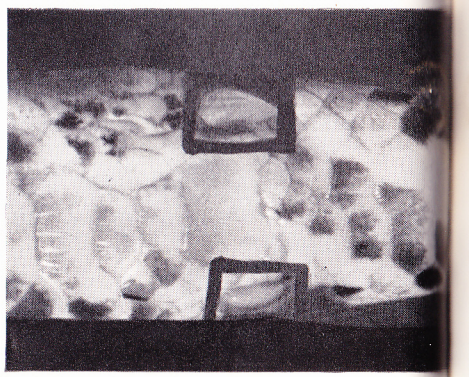


Fig. 12(a) Anal spurs as appendages of a Python.

(*b*) Internal appendages in Typhlops.

(*b*)

(*a*)

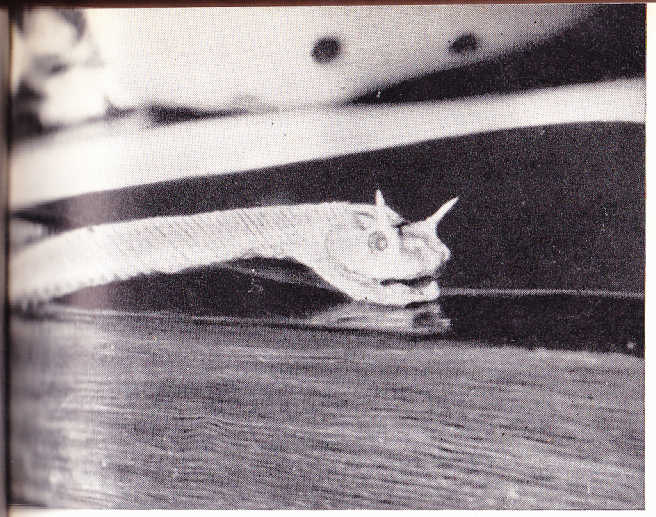
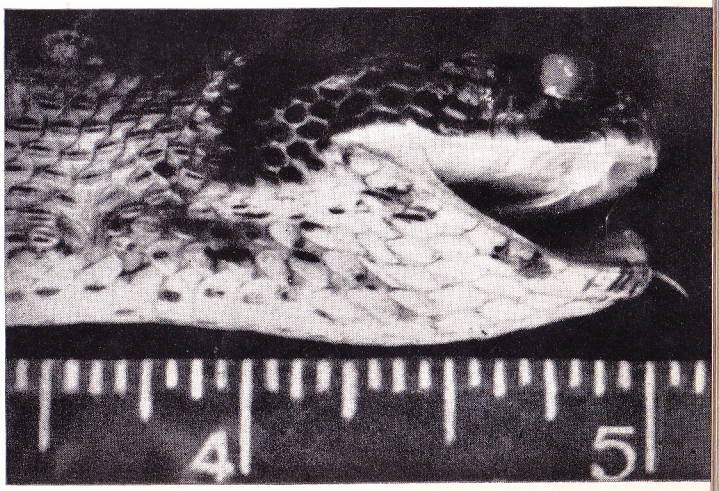


Fig. 13. "Horns" on the head of *Pseudocerastes persecus*.

Fig. 14. Keeled and serrated "Saw scaled" scales of *Echis carinatus*.



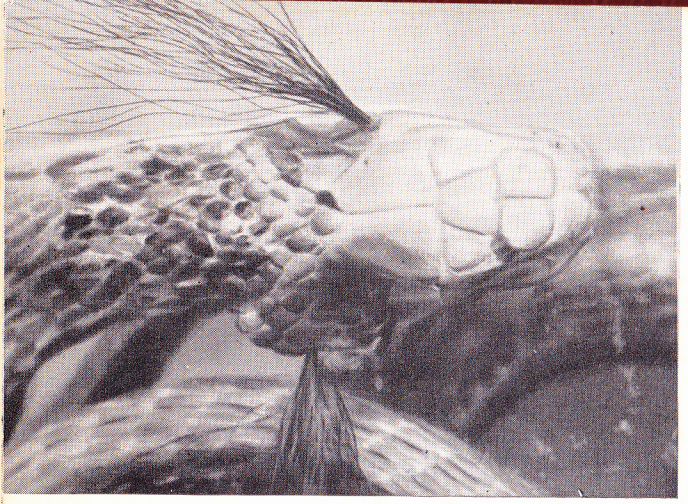
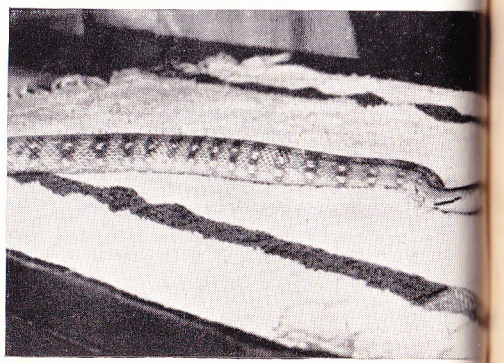


Fig. 15. "Hairs" (moustache) planted on a cobra head.

Fig. 31. *Boiga gokool.*
Characteristic pose of head before strik



(*Figure VIII col.*) or pit viper *Trimeresurus gramineus*, reddish pit vipers in the Himalayan region, chrome yellow cobra before rains and yellow black stripes or marks in banded krait or *Rhinops* sp., patterns of colours in yellow and black spots as in *Ptyas mucosus*, the rat snake, olive green with yellow stripes in King Cobra and the same background with checkered black spots in the water snake *Natrix piscator* are an indication of the variety of colouration that is met with in snakes. In between these, stripes and dots of different colours are also there with iridescence and markings that have various shapes. The markings could be noted in *Echis carinatus* which has an arrow on its head or a python which has between its eyes a javelin-shaped mark. These colourations are in tune with ecological conditions, for example, the Russell's viper which lives in shadows and in woods, has rows of dark brown spots on a brown background which makes it invisible until it makes the hissing noise.

Limbs

The animals in this group are elongated and devoid of any limbs. In primitive blind snakes there are vestiges of a pelvic girdle. In Boidae, the python, has two horny spurs near the anal opening which are capable of a vigorous movement and could inflict serious scratching injuries (*Figure 12a*). These are vestiges of limbs. In the horned viper *Pseudocerestes persecus*, there are small horn-like projections on the head (*Figure 13*).

Scales and Skin

The body is covered by scales. The scaly covering is overlaid by a thin skin that is cast off regularly. Before this casting off, the colour of the snake becomes whitish, like a bubble filled with smoke. An oily secretion is rubbed between scales and skin, while the skin is cast off like a coat taken off inside out. During the period when the snake is on skin, it is sluggish and due to the opaqueness on the eye, the animal cannot see far. It has been noticed that if the snake cannot cast away the skin regularly at the usual intervals, the animal becomes ill. It has also been noticed that if due to some cause the skin is not cast off completely, it again feels very

ill with partly attached skin sticking to the body. At the Haffkine Institute the periodicity of the casting of the skin in the snake has been observed. The periodicity differs according to the sex and age of the snake. It is more frequent in the summer months and less during the colder season. It ranges from 72 to 210 days. In a newly born Russell's viper, the first casting was within 2 days, the second after 7 days and the third after 21 days. Thereafter it went on casting at varying intervals. These have also been observed in young cobras bred in that laboratory.

The scales on the head are called shields. The classification of snakes is based on the size and disposition of the various head shields in different snakes. In some snakes the scales are keeled. *Echis carinatus* or Phoorsa, rubs these keeled scales to produce a noise when disturbed (*Figure 14*). The broad ventral scales are useful to the snake in taking a grip during locomotion. If a snake is placed in water or is made to go over a very smooth surface, the locomotion is hindered and the snake cannot make much progress.

Hairs

It may clearly be mentioned here that the external covering of the snake are the scales. It is a common belief in Indian villages that old snakes have white hairs. This is not true. This notion is erroneous, and we have seen a cobra in which horse hair had been planted to create a false impression of this type to earn money from credulous villagers (*Figure 15*).

Jaws

In general, the lower jawbone in a snake is not one unit, but there are two bones in front joined by an elastic ligament. Further, the lower jaw is not properly articulated with the upper jaw. Both these structural changes therefore permit the python to extend the jaw even upto an angle of 180°, which enables the snake to squeeze in a prey which looks rather big for its mouth. The bifid tongue normally sticks out of the region where the lower jaw has not been articulated properly.

Teeth

There are curved pointed teeth on both the jaws as well as palate of snakes (*Figure 16*). These pointed teeth may be of various sizes and in Python they are lancet shaped. These inflict a very severe injury in a bite. The recurved teeth hold a prey from escaping and help the propulsion of the food into the mouth. In primitive snakes like *Typhlops* jaws are toothless except for a few teeth on the transverse edges of the maxillary bones, almost corresponding to the palatine bones. In poisonous snakes the upper marginal teeth on the maxilla do not exist. These snakes have developed special curved teeth which are canalised like a hypodermic syringe needle and are movable as in the case of Russell's viper. These teeth in Russell's viper are about 1 cm. in length. The teeth being too big, lie tucked up by the side of the jaw when in repose. At the base of these canalised teeth opens the duct of the poison glands. These modified teeth are thus movable and also have a sheath in Russell's viper. In the case of a cobra they are $\frac{1}{2}$ cm. without a sheath and are not movable. These modified teeth are called fangs.

Fangs

The fangs of the poisonous snakes are present on the premaxilla and not on the mandibles. At the base of the fangs are buds of newer fangs. When a fang is broken, its place is taken by a new one developed out of the buds. The new fangs emerge in three to six weeks. It should therefore be borne in mind that a fangless snake may soon develop them and inject the venom. Secondly a snake which has bitten once is quite capable of biting again with fatal effect. At the base of the fangs open the ducts of the poison gland which are modified parotid salivary glands.

The fangs (*Figure 16*) in the poisonous snake may be situated in the front regions, as in a cobra or viper or they may lie slightly behind, as in a number of sea snakes. These latter snakes are quite poisonous, but they cannot get a full grip and inject the poison, because the fangs are situated far back on the jaw. That is why there are comparatively few deaths from their bites in India.

The fangs may have a gutter at the upper side. The incurved sides of this gutter forms a channel. This is seen in cobras where

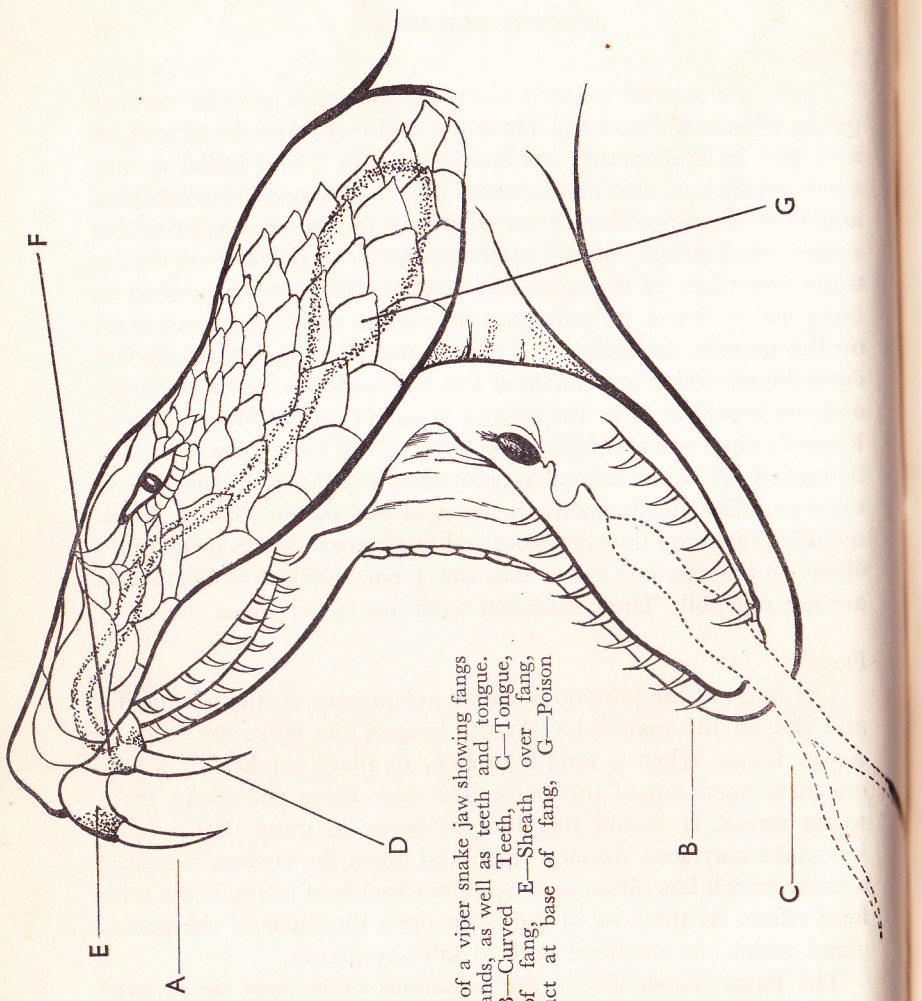


Fig. 16. Line drawing of a viper snake jaw showing fangs and poison glands, as well as teeth and tongue.
A—Fang, B—Curved Teeth, C—Tongue, D—Orifice of fang, E—Sheath over fang, F—Poison duct at base of fang, G—Poison gland.

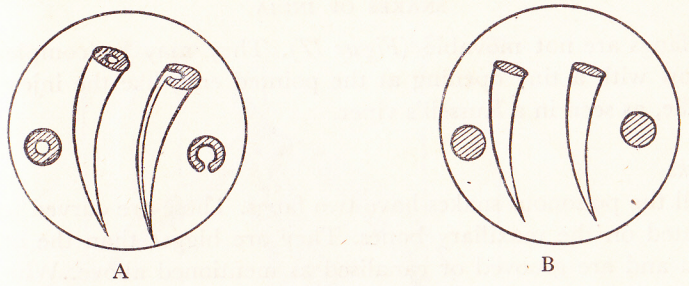


Fig. 17. Line drawings of "fangs" of snakes.
A—Canalised teeth of Russell's viper along with gutter teeth of Cobra. B—Solid teeth from lower jaw.

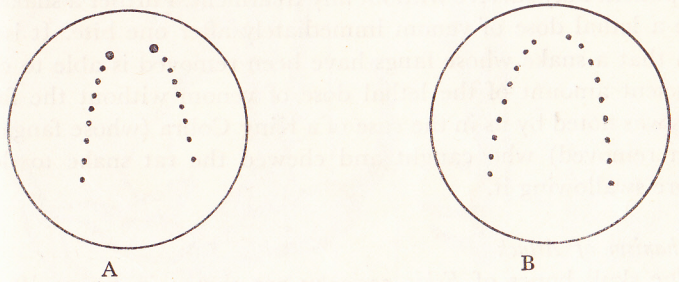


Fig. 18. A—Diagramatic representation of the marks left by the bite of a poisonous snake. Note the two big first round marks. B—The marks supposed to be left after the bite by a non-poisonous snake. Note the absence of first two big marks and uniform tiny fine punctures.

the fangs are not movable (*Figure 17*). They may be completely hollow with a tiny opening at the pointed end, like the injection needle, as seen in a Russell's viper.

Marks

All the poisonous snakes have two fangs. These are curved teeth situated on the maxillary bones. They are bigger than the other teeth and are grooved or canalised as mentioned above. When a poisonous snake bites, it normally leaves two deep fang impressions slightly separated from each other, apart from small marks of the other teeth (*Figure 18A*). When a non-poisonous snake bites, it should leave a number of small impressions in a row (*Figure 18B*). Many a times the marks may not be so regular. The snake may not have been able to take a proper bite. In such cases which are quite common, there may be a few marks or even a small laceration which occurred when the snake struck in a hurry.

It is not always that a snake which has bitten may have injected venom. It is also not always that a poisonous snake that has bitten has been able to give a lethal dose of venom. In both these cases the patient may survive without any treatment. Further a snake can give a lethal dose of venom immediately after one bite. It is also seen that a snake whose fangs have been removed is able to chew sufficient amount of the lethal dose of venom without the fangs. This was noted by us in the case of a King Cobra (whose fangs had been removed) who caught and chewed the rat snake to death before swallowing it.

Mechanism of Attack

The skull bones of *Echis carinatus* are shown in figure 19. In this figure the location of the quadrate bone and the pterygoid as levers is to be carefully noted. These bones along with the squamosal play a vital role in manipulating the other skull bones, to open the mouth and help the fangs during the mechanism of attack.

The Russell's viper snake prepares to bite by raising its head a little above the rest of the body. The neck and the upper end of the trunk are not shaped into a complete circle, but lie in two or three abrupt curves across the mass of the coiled body.

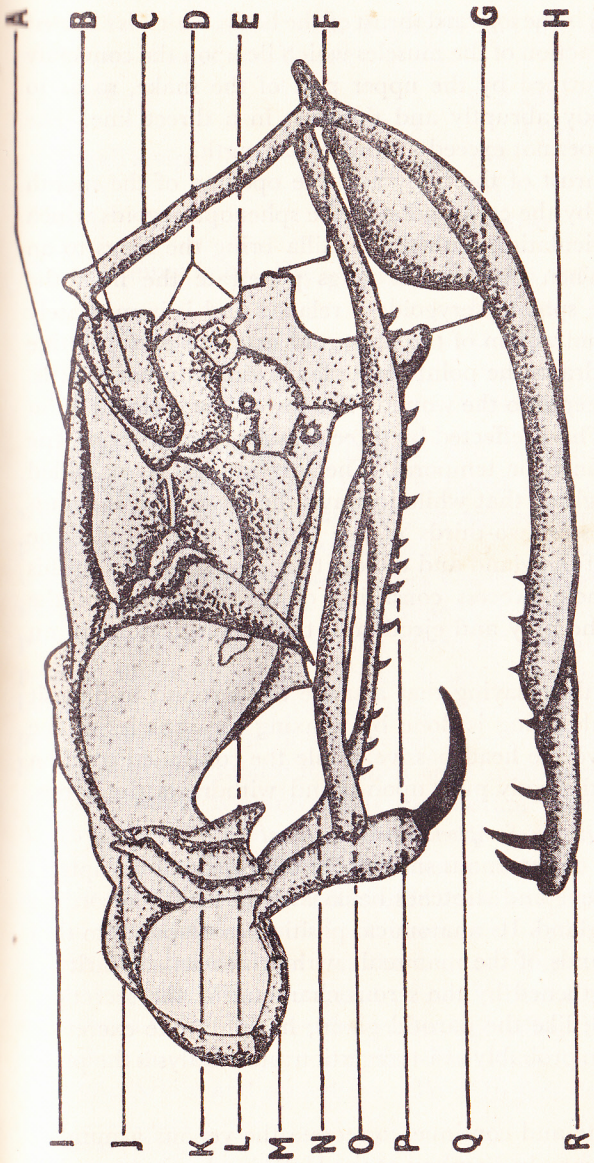


Fig. 19. Lateral view of the skull of *Echis carinatus*.

A — Parietal bone
B — Squamosal bone
C — Quadrate bone
D — Foramen magnum
E — Collumella auris
F — Occipital condyle
G — Basi-occipital spine
H — Angular bone
I — Frontal bone
J — Nasal bone
K — Lacrymal bone
L — Inter-orbital septum
M — Premaxilla
N — Palatine bone
O — Transpalatine bone
P — Pterygoid bone
Q — Fangs
R — Dentry bone with solid teeth.

The next phase is the forward thrust of the body, which is effected by a sudden contraction of the muscles which lie upon the convexity of the bendings formed by the upper part of the snake, so as to straighten the body abruptly and thrust it in a direct line. The projectile range does not exceed a third of its length.

The forward thrust of the body and the opening of the mouth are accompanied by the contraction of the sphenopterygoids which through their articulation with the maxilla bring the fangs to an erect position. When the erected fangs penetrate the flesh the contraction of the sphenopterygoids is relaxed and is immediately succeeded by a contraction of the pterygoid externus and palatine (*Figure 19*). This draws the point of the fangs violently backwards, so as to drive it deep into the wound. The lower jaw is closed upon the bitten parts. This is effected by three muscles, the posterior, the middle and the anterior temporal. The last muscle is so folded about the poison gland that while it draws the lower jaw, it simultaneously compresses two-thirds of the body of the gland. The anterior portion of the gland and the duct are also subjected to this pressure. The whole process consisting of the deepening of the wound, holding the prey and ejection of the venom is done in an instant.

There is no truth in saying that a snake turns round to deposit the venom. Disentangling is done by relaxing the muscles of the neck, so as to leave the head passive, while the continued traction of the muscles of the body pulls upon it and withdraws the fangs.

Snake-venom, Constituents, Symptoms and Treatment

In the majority of venomous snakes, the poison gland occupies a space behind the eye and stretches backwards in length according to the size of the gland. Its anatomical position corresponds to that of the parotid glands of the mammals with which its similarity is still further strengthened by the serous character of the secretion. The venom gland, like the parotid gland, has only one excretory duct. The secretion probably assists digestion and paralyses the prey.

Venom Secretion

A snake can bite and continue to secrete the venom a number of times in succession. In Bombay at the Haffkine Institute, snakes

are milked for venom once a month and the average yield per snake per time is as follows[1]:

Cobra	0·2 gm of the dry weight of Lyophilised venom	
Russell's viper	0·15	—do—
Krait	0·022	—do—
Echis	0·0046	—do—

The maximum lethal dose of these venoms for a man is:

Cobra	12 mgm
Russell's viper	15 mgm
Krait	6 mgm
Echis	8 mgm

It has been noted by Deoras and Mhashalkar that non-poisonous snakes do have in their blood sera certain inhibitors which protect them to some degree against the venom of some poisonous snakes.[2] I have noted the case of a worker in Florida who used to take a gradual dose of cobra venom whereby he could withstand some doses of pure cobra venom. In fact the serum of this person saved the life of a victim bitten by a coral snake. It is thus possible to get immunity against snake poison by gradual doses, but this immunity may not last long and secondly such immunised person may die if the dose of venom received later, happens to be higher than the amount for which he is immunised.

Cobra venom is extracted at the Haffkine Institute by allowing the snakes to bite a plastic cloth covered tightly over a wine glass (*Figure 20*). The Russell's viper venom is collected by allowing the snake fangs to adjust squeezing inside the uncovered glass (*Figure 21*).

The poison of a cobra is faint transparent yellow and is slightly viscous. The fresh venom contains mucus along with enzymes and other secretions. When exposed to sun it becomes slightly turbid. The viscosity of the venom varies according to the season. It is thicker during winter months. The Russell's viper venom is sometimes white and sometimes yellow. In fact during differential

[1] Deoras (1959).
[2] Deoras and Mhashalkar (1963).

milking the right fang gave one colour and the left the other. We have seen that the venom given by cobra and krait snakes in the open snake farm when dried is more in weight than that of a Russell's viper.[1] Secondly, the male snakes in cobra and krait gave more venom than the females. It is not so rigid in a Russell's viper. Thirdly, the volume of venom secreted by a Russell's viper is more than that in a cobra of the same size, but the dry weight of this volume is less than the dry weight of cobra venom. It is probably this reason which explains the fact of swellings seen after the bite of a Russell's viper, wherein more liquid has been injected into the tissues. Fourthly, it is noted that there is variation in the output of venom during different seasons. During the summer months the output is more and probably the lethal dose of this venom is higher. In winter the venom is viscous and comes out in small quantities. This latter venom probably has a lower lethal dose. These factors may explain the higher mortality rate by snake bites in summer months including the monsoon. A black cobra has been seen to give more venom than the brown one, so also a King Cobra gives more venom than the ordinary one. These factors may account for the belief that these black and King Cobras are more poisonous.

The snake has venom from the very first day of its life. It can bite, but the amount of venom given may not be in sufficient quantities. After a certain age there is not much difference in the output of venom in snakes of the same species and this has been noticed in a cobra.

The venom is acidic to litmus paper and has a specific gravity ranging from 1·030 to 1·070. On drying it settles down to fine needle like crystals which will readily dissolve in water and this solubility is retained for a long time. The venom can be handled with safety provided it does not come in contact with blood or the mucous membrane. It could be taken *ad lib* provided there is no cut from this end to the other. The patient may escape with some symptoms if there is no cut and the venom has not come in contact with blood. In fact we have seen people taking oil in the

[1] Deoras (1961).

mouth first, and then trying to suck out poison from bitten parts. This is highly dangerous and should always be discouraged.

Constituents

Kellaway[1] and Porges[2] attributed the toxic actions of venoms to proteolytic enzymes, phosphatidases and neurotoxins.

The venom of the snake is a highly concentrated digestive juice. In different species of snakes this mixture of proteins varies in composition from one another.

Venoms with coagulant properties fall into two groups. The first includes the most powerful proteolytic venoms which coagulate pure fibrinogen in vitro without calcium ions, tissue extract and prothrombin. The proteolytic enzymes in these venoms behave like papain, converting fibrinogen into fibrillar gel.

The venoms of the second group are unable to coagulate pure fibrinogen. They convert prothrombin to thrombin. The activity of these substances is analogous to that of trypsin, but is many times more potent. The proteolytic enzymes may contribute to the hypertensive action of snake venom, through the damage to muscular endothelium, with the consequent escape of blood from the vessels and possibly liberation of histamine.

Phosphatidases play an important part in poisoning, causing haemolysis and most of the effects on the heart and circulation. Haemolysis by venom is accelerated by lecithin, since oleic acid splits off to form lysolecithin. This later acts on isolated heart muscles and causes, among other effects, contractures, fibrillation, increased inhibition of water, loss of potassium and excitability. It attacks capillary endothelium and causes haemorrhage of the lungs. Cobra venom is more active in dilute than in strong solutions, because lecithin is absorbed by proteins which coagulate in the concentrated venom.

Neuro-toxins exert various actions on the nervous tissue and produce a curare like effect as well as paralysis. *Neuro-toxins* of cobra venom are concentrated in a protein fraction, containing about 21 per cent of the original protein of the venom.

Other enzymes in the venom consist of the following:

[1] Kellaway (1939).
[2] Porges (1963).

Proteases in cobra and Russell's viper resemble trypsin which is a highly digestive enzyme.

Erepsin has been found as other phosphoesterases.

Cholinesterase: This acetylcholine inactivating enzyme found in cobra venom acts to produce choline and acetic acid. It is probably not found in viperine snakes.

Hyaluronidase: This agent enhances the spreading of infectious agents in the skin of mammals. Hyaluronic acid has the important function of resistance to penetration by foreign matter. This resistance breaks down under the action of hyaluronidase.

The rapid diffusion of venoms is prevented by the intercellular gel of the connective tissues, which forms a strong barrier. This barrier may be overcome with the aid of hyaluronidase, a solubilysing enzyme.

Ribonuclease and Desoxyribonuclease

The hydrolyzing action of these enzymes probably implements the toxicity of venoms by supplementing the hydrolytic activity of other enzymes known to be present in venoms. The venoms with great neurotoxic activity like that in the cobra and the krait exhibit high activity of these enzymes.

Ophio-oxidase

It is a non-toxic component that causes a protease enhancing effect by liberating proteases and peptides bound up in the cell itself. Apart from being a digestive agent, it hastens autolysis and putrefaction.

Summing up the topic of venoms, it may be noted that these are primarily helpmates in digestion. These powerful enzymes therefore have a strong effect. The hyaluronidase help in spreading the venom and ophio-oxidase in autolysis and putrefaction. Neurotoxins paralyse the prey. Lecithinase attack the limpid layers of the endothelial cell linings, producing lysolecithin and helping in the increase of fragility and permeability for breakage of cells. Proteases lead to dissolution of blood vessels and spill over of erythrocyte and serum in the tissue. Thus the venom constituents have toxic action, enzymatic activity and other diverse properties responsible in aiding digestion.

Symptoms of Poisoning

Normally one gets bitten in the extremities of the limbs. If any person is ever bitten directly into an important blood vessel like the jugular vein or the carotid artery etc., which is an extremely rare possibility, the symptoms may start immediately and the effect will be earlier than, say a few minutes only. In the case of Russell's viper if the venom has thus gone into direct circulation, violent convulsions will rapidly set in and death will follow immediately.

It must be carefully noted that a majority of snakes are non-poisonous and it is the ignorance about snakes that causes psychological shock and even death. Also a poisonous snake may not have put in a lethal dose of venom and in such cases, the patient may not show any symptoms. A non-poisonous snake may not be able to give venom, but in view of its ecology it can certainly transmit tetanus or gas-gangrene in the wound inflicted. A patient may thus suffer from the after-effects of the physical harm by the wound and the subsequent foreign infection. The non-poisonous snake bite may thus give tetanus or gas-gangrene. The mere fact of bite may cause a psychological upset and give rise to some symptoms even if there is no injury or injection of venom. Lastly, there may not have been any injection of a lethal dose of venom. Apart from all these cases, if a poisonous snake has struck and a sufficient amount of venom has been injected, one should expect the following broad symptoms for treatment.[1]

Cobra

If the venom has been injected local symptoms start within six to eight minutes:

1. The spot develops a small reddish wheal and is tender. There is some sensation and slight burning pain at the site of the bite.
2. After about 25 minutes, constitutional symptoms begin to appear. The patient feels sleepy, slightly intoxicated, weak in legs and shows a disinclination to stand or move.

[1] Essex, H. E. (1945).

3. After 35 to 50 minutes, there is profuse salivation and even vomiting. This is followed by a paralysis and swelling of the tongue and the larynx. Thus he cannot swallow or speak coherently.
4. After about a couple of hours, the paralysis is complete. Respiration becomes slower and the action of the heart quickens. The patient is conscious, but is unable to speak.
5. Finally respiration ceases with or without convulsions and the heart soon stops.

Krait

In the case of this snake bite, the symptoms are similar to those of a cobra bite, except that there is no swelling or burning pain at the site of the bite and the convulsions are a bit milder, while the feeling of drowsiness and intoxication is more intense. Albumen may be detected in the urine in case of this snake bite, while in the case of cobra it is not seen.

Russell's Viper and Echis Carinatus:

1. The spot develops a severe pain within eight minutes. The area around the injury is red and painful.
2. The onset of swelling starts within 15 minutes and there is often a blood-stained discharge from the wounds.
3. There is a marked feeling of intense pain, thready pulse, cold sweat, vomiting, followed by dilated pupils getting insensitive to light.
4. In about an hour or two, there is a marked collapse and often complete loss of consciousness.
5. In case the above symptoms show a sign of improvement, the local symptoms start playing an important role in the case. There is a large extra-vasation of blood followed by a lot of edema all around the wound with a general increase in the swelling.
6. Towards the end there is an extensive suppuration and sloughing, followed by a malignant edema. This is followed particularly in Echis by severe haemorrhages from rectum and other orifices in the body.

There is no paralysis in the case of these snake bites.

In the case of Echis, the patient may not die, but the secondary symptoms continue for days, as he goes on bleeding from different orifices, even from gums and the wound shows mild symptoms of necrosis. We have seen in a recent case of Russell's viper bite that at the site of bite the skin became dark after four days and the necrotic area had to be cut out. Antivenin had been given but not infiltrated at the site of bite. (*Figure 22.*)

First Aid

Snake bite should be treated immediately. The following first-aid measures have definitely proved their value:

Ligation: A ligature of some type should be tied a little above the bitten part. This would prevent the venom from being absorbed into the upper part of the limb. The ligature may be a strip of cloth, a large handkerchief, or even a piece of heavy cord. A rubber ligature is the best. It is necessary to make the ligature sufficiently tight to cause a stoppage of circulation. Ligation should not continue for more than half an hour and should always be slackened off every ten minutes during this time.

Incision: After retarding the absorption of poison in this manner, the fang-wounds should be opened by cross incisions a quarter of an inch long and a tenth of an inch deep over each fang mark. The incisions should be made with care by a sterile stainless steel knife or lancet so as not to injure the delicate membrane covering a bone or cut into a blood vessel.

Suction: Drainage of blood and lymph from the cuts should be induced by suction. This is more useful in viperine bites. Suction should be done mechanically by means of a cupping device which consists of a glass or metal cup with a rubber suction bulb attached to it. There should be at least two different sizes of cups in a snake-bite kit, one of glass with a round opening of about one inch diameter for flat surfaces and another of metal with narrow oval opening for finger and other round parts. Mechanical suction should continue several hours after ligation has ceased. During intervals, the incisions should be covered with pieces of cloth dipped in a solution of table salt or Epsom salt in water. This will promote drainage of lymph by osmosis.

Caution: It will be desirable to wash the incisions with a weak solution of potassium permanganate crystals in pure water. This solution should be of pale amethyst hue. The solution will also neutralise by oxidation the venom it may reach. But it is very dangerous to apply crystals or strong solution of potassium permanganate to the wounds. Cauterizing the wounds is worse still as it actually seals the deadly poison within the tissue. The function of the solution is to prevent infection.

It is well to remember that if nothing happens within ten minutes following the bite, the snake was harmless or had no venom when it bit.

It is now established that the first aid may not be fully useful in the case of neurotoxic poisons. Anyway it will be sufficiently effective psychologically. Secondly, it has also been shown now that these extra incisions in the case of viperine poisoning often create further local symptoms. Cryotherapy has been advised by some workers. Herein the bitten parts are tried to be frozen immediately to prevent further absorption of the venom in the tissue. But in this case also there are chances of complications in local symptoms. The only sure remedy is the specific serum treatment.

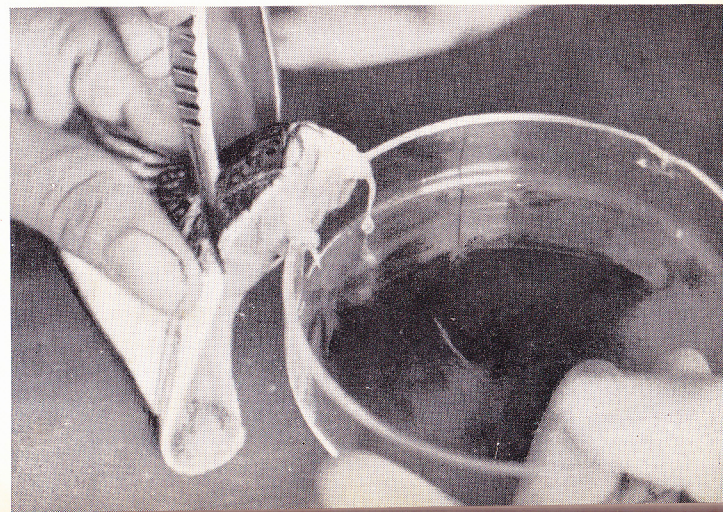
In fact in Brazil they advocate immediate injection of the serum substantially, in the muscle region below the scapula.

Specific Serum Treatment

Once the venom has got into the circulation, it is only the anti-snake-venom serum that can neutralize it and in order to derive the greatest benefit out of serum treatment, the serum should be injected soon after the bite. As a first dose, at least 10 cc of the reconstituted serum should be injected intravenously. The second dose should be repeated one hour after the first dose or even earlier, if symptoms persist. If the symptoms, which vary with different venoms, indicate persistence of venom action, further doses should be repeated every six hours until the symptoms completely disappear. In the case of a viper bite some serum should also be injected round the site of the bite, to prevent gangrene which otherwise results owing to the very destructive effect of localized viper venom on tissue.

Fig. 20. Extraction of a cobra venom. The snake is made to bite a plastic cloth tied tightly over a wine glass.

Fig. 21. Extraction of venom from a Russell's viper. The fangs being big and in sheath are allowed to strike a petri-dish.



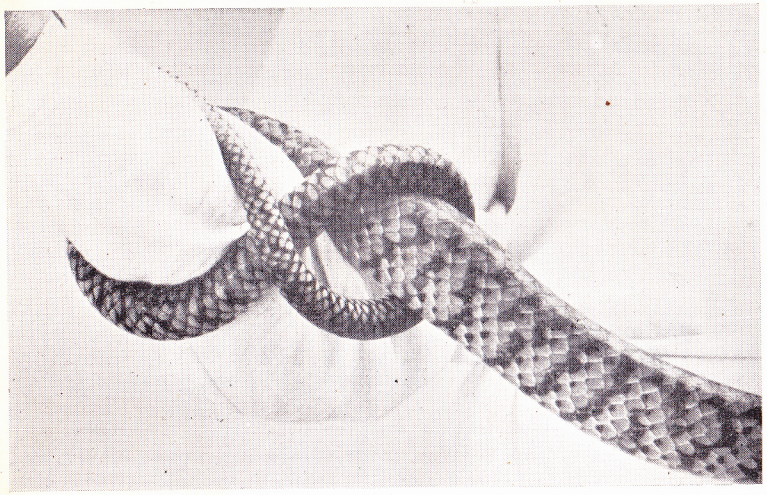


Fig. 23. Rat snake tying a " scout " type of knot.

Fig. 22. Damage caused to the hand of a patient six days after the bite of a Russell's viper, where antivenin has not been infiltrated at the site of bite.

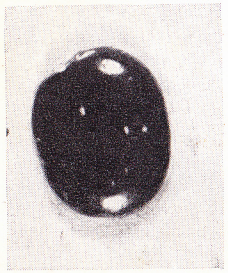
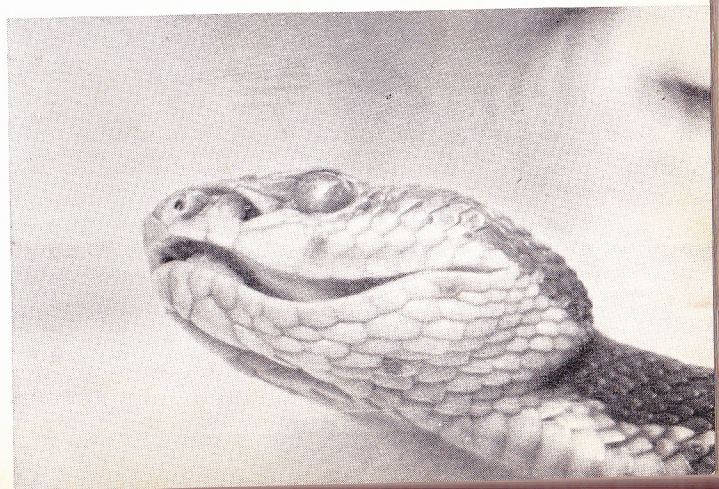
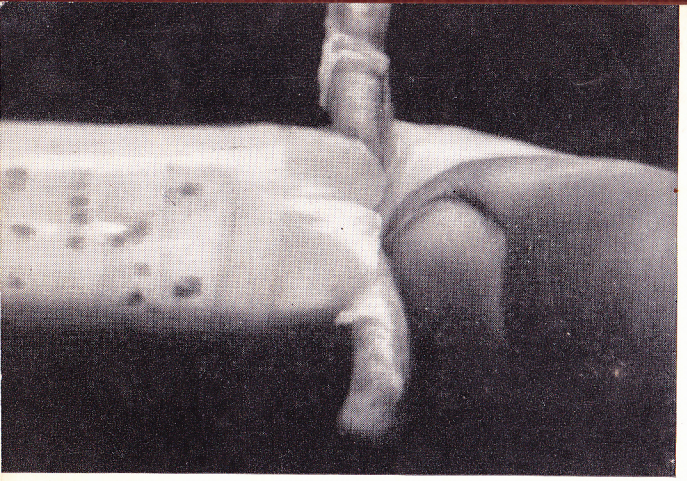


Fig. 24. Snake " Jewel ".

Fig. 25. A snake round the neck of late Shri Jawaharlal Nehru.

Fig. 26. The " pit " in the green pit viper. The structure is noticed to the right of the nasal opening seen in this figure.





(*a*)

Fig. 30. Showing penis sticking out, if a thumb is run upwards from the tail end.

(*a*) In a cobra.

(*b*) Spinous penis of *Echis carinatus*.

(*b*)

Polyvalent Anti-Snake Venom Serum

In India at the Haffkine Institute the anti-snake-venom serum is prepared by hyper-immunizing horses against the venoms of the four common poisonous snakes: (1) Cobra (*Naja naja*), (2) Common Krait (*Bungarus caeruleus*), (3) Russell's viper (*Vipera russelli*) and (4) Saw-scaled Viper (*Echis carinatus*). Plasma obtained from the hyper-immunized horses is concentrated and purified. Each c.c. of the concentrated serum neutralizes not less than the following quantities of dried venoms, when the serum is injected along with the venoms intravenously into white mice: Cobra 0·6 mg., Common Krait 0·45 mg., Russell's viper 0·6 mg., and Saw-scaled Viper 0·45 mg.

Haffkine Institute Report mentions that 1 ml. of their polyvalent antivenin was able to neutralize 0·5 mg. (20 mld.) of a King Cobra venom (Naja hannah).[1]

The serum is lyophilised by drying it from the frozen state under high vacuum. The drying process is continued until the moisture content is reduced to less than 1 per cent. The dried serum, however, retains its affinity for water to the fullest extent and therefore dissolves rapidly on adding water. This property is maintained by the dried venom even after storage for many years.

The venoms of cobra and common krait act very rapidly if a large amount of venom is absorbed into the circulation. Hence it must be understood that unless the absorption of the venom into the circulation is retarded by ligation, incision and suction, the anti-snake-venom serum does not get a fair chance to neutralize the venom and save the victim. First-aid treatment should therefore never be relaxed even when the serum is administered.

Intravenous injection of serum in horse-serum sensitive subjects can produce very severe serum sickness and even acute anaphylaxis. Every care should be taken to prevent these reactions.

Intramuscular or subcutaneous injections of the anti-snake-venom serum are not as quickly effective as intravenous injections. But if expert medical aid is not available, the serum may be administered by the subcutaneous or the intramuscular route. The

[1] Haffkine Institute Report (1958, p. 5).

dosage should then be increased by two to three times from that recommended for administration by the intravenous route.

Prevention of Serum Sickness

In administering any horse serum product for therapeutic purposes certain precautions must be taken, particularly in case of patients known to be sensitive to horse serum. However, persons dangerously hypersensitive to horse serum are exceedingly rare, and therefore when there is a definite indication for any anti-sera the treatment should not be put off on account of the probability of an anaphylactic shock. It must be emphasized, that grave disadvantages may result to the patient concerned by exaggerating this possibility and postponing serum treatment.

Precautions

It should be ascertained if the patient has ever been treated with any horse serum product. History of personal or hereditary allergy, if any, should also be carefully noted. If the patient has, at any time, previously received an injection of horse anti-serum or if he has ever displayed an allergic reaction caused by the proximity to horse, the intradermal skin test, and if necessary also the ophthalmic test for sensitivity to horse serum must be done.

Intradermal Skin Test

This test is given by injecting intracutaneously into the flexor surface of the forearm 0·05 cc to 0·1 cc of 1 : 10 dilution prepared from a portion of therapeutic serum to be administered. Positive reaction is indicated by a rapid enlargement of the primary elevation which becomes urticarial in appearance surrounded by a zone of erythema in about five to twenty minutes. A wheal one centimetre in diameter surrounded by an erythema of about the same width is significant. Erythema is hardly noticeable in deeply pigmented skin. In such cases, appearance of a wheal only should be taken into account. Pseudopodial extensions of the central wheal are evidence of a higher or more dangerous degree of sensitivity.

If the test is negative, the elevation due to injection disappears in a few minutes.

Normal horse serum should never be used for giving the intradermal skin sensitivity test. But a portion of the antiserum to be injected should be utilised. In susceptible patients an injection of even 0·1 cc of 1 : 10 dilution of normal horse serum may cause fatal anaphylaxis and severe serum reactions.

Ophthalmic Test

The lower lid of one of the eyes is everted and one drop of undiluted therapeutic serum is placed into the conjunctival sac. A positive reaction is indicated by itching, burning, congestion and lacrymation appearing within fifteen to twenty-five minutes. A drop of adrenalin chloride solution 1 : 1,000 will relieve the symptoms and should be put into the conjunctiva in every positive case. Positive ophthalmic test indicates a dangerous degree of hypersensitivity. Utmost care and precaution is therefore called for in administering serum to patients showing positive ophthalmic test.

Desensitization of Serum Sensitive

If the skin test, or the ophthalmic test, is positive, the patient should be desensitized. In case of mild skin reaction and negative ophthalmic test, 0·5 cc to 1·0 cc of antiserum is injected about some time before the administration of a full therapeutic dose. In case of severe skin reaction and positive ophthalmic test, 0·1 cc of serum is injected subcutaneously. The dose is doubled every half hour until the full amount is administered. After this preliminary desensitization subsequent injections may be given by any route and in full doses. It must, however, be remembered that the patient becomes serum sensitive again a few weeks after this desensitization.

Care in the Injection of Antiserum

Intravenous or intrathecal injections must always be given slowly, preferably by the gravity method. If conditions permit, these injections should be preceded by an initial treatment given

intramuscularly a few minutes previously. While injecting intravenously, the antiserum should be diluted 1 : 5 to 1 : 10 with sterile pyrogen-free physiological salt solution. While injecting intrathecally, at first only a few drops of diluted serum should be administered and with the needle still in the spinal canal, the patient should be observed for five minutes to see if any reaction occurs before completing the injection.

The following two methods have also been recommended in case of persons sensitive to serum :

1. 10 cc of the polyvalent antivenom may be given in an intravenous drip in 100 cc of glucose saline with vitamin C, calcium and coramine. There should, of course, be a separate injection of adrenaline before the drip starts. Some doctors advise a subcutaneous injection with hyalase.
2. (*a*) Inject 1 cc coramine intramuscularly.
(*b*) Inject 1 cc adrenaline or any antihistamin intramuscularly.
(*c*) Observe the serum sensitiveness of the patient. Inject 0·5 cc of the serum slowly subcutaneously.
(*d*) If the person is sensitive, inject 1 cc subcutaneously, after two minutes inject 2 cc by the same route and wait for fifteen minutes. Inject 10 cc subcutaneously and wait for thirty minutes. Inject 40 cc subcutaneously very slowly and wait for ten minutes. Inject 10 cc by intravenous route and wait for fifteen minutes. Inject 10 cc again by intravenous route and wait for one hour to observe further symptoms.

However, adrenalin and coramine should always be ready for administration in 1 cc doses.

Treatment of serum sickness

With the first symptoms of serum reaction, 0·5 cc to 1·00 cc of adrenalin chloride solution 1 in 1,000 should be injected subcutaneously. For children 0·2 cc to 0·33 cc is usually an adequate dose. Lotio calaminae and cold applications about the point of injection are of benefit. Sodium bicarbonate bath may be used. Fluid should be injected sufficiently and free elimination should be encouraged.

In the case of accelerated reaction, which is usually observed in those who have received serum at some previous time, adrenalin chloride solution treatment should be used more actively. This form usually develops in two stages. The primary reaction is local and occurs a few hours after injection. The secondary symptoms of more pronounced serum sickness usually appear four to seven days after injection.

True cases of acute anaphylaxis very seldom occur. The symptoms of acute anaphylaxis develop very quickly after serum treatment, usually within a few minutes of starting the injection. This must immediately be discontinued and a tourniquet applied proximal to the point of injection. Adrenalin should be injected immediately at some point other than where tourniquet has been applied and repeated at frequent intervals. After the control of acute symptoms sedatives may be given.

Sometimes there is sloughing of the tissues at the site of injection due to local anaphylaxis. Such reactions may be avoided by the selection, for re-injection of antisera, of only those sites that have not received any injection of antisera previously. If sloughing occurs, the part should be elevated and treated with iced compresses and sulphathiazole paste.

In some cases signs of serum reactions appear a number of days after injection of serum. They are usually very mild and pass off without any treatment and should therefore cause no apprehension.

Associated treatment

In cases of Russell's viper and Saw-scaled Viper poisonings sedatives, such as morphine, small doses of barbiturate or aspirin may be given to relieve pain and nervousness. They should, however, be used with care in cobra and krait poisonings. In case of collapse, strychnine, pituitrin or other general stimulants are of special value. In all severely poisoned cases, great relief is likely to be experienced from the infusion of a large amount of physiological saline, or better still, transfusion of blood or plasma, the effects of which may be life-saving in border-line cases.

Snake Food and Feeding

Snakes normally go in for live food only. In laboratory trials it was noted that poisonous snakes preferred a mammal to an amphibia *i.e.* a mouse to a frog.[1] In these experiments it was also indicated that the calcium content of the mammal blood was nearly half to that of amphibia and reptiles. A frog of equal weight took more time to die than a mouse after injecting equal doses of cobra venom. A poisonous snake strikes the victim and withdraws to avoid retaliation and keeps hovering round until the animal is dead. The snake will then move by the scent towards the head of the victim. The tongue will test the heat and other sensations. The mouth will open and the head of the mouse will go first and the teeth will act as propellers to push the mouse in. The entire mouse of about 20 gm. in weight is engulfed in three to four minutes. One can see the mouse going beyond the neck region along with the pushing and peristaltic motions of the digestive tract. After the meal, the snake raises its head, opens its mouth and then closing it, settles down for rest and digestion. The venom acts as a paralysing agent and also as a digestive juice for the snake. These and other digestive juices are responsible for the digestion. They can digest anything except nails and feathers. Snake poison contains papain, oxidases and other chemicals that help in disintegrating and digesting the tissues. Once having fed, the snake will not need food for some days.

Snake is not a vegetarian. It may sip some milk, but this is primarily as a liquid in lieu of water. No snake can live long on milk alone.

Amongst non-poisonous snakes, the python opens its mouth and from a coiled condition hurls itself at the victim, the mouth is closed round the victim and instantly the huge body coils round the victim and exert a pressure. A 200 gm. rat when so attacked is asphyxiated within three minutes. One can see the lips of the rat turning blue gradually. The snake keeps the coil till the animal is dead and then eats it from the mouth end. A well developed python can thus kill a dog and a deer too. After this the snake will go for

[1] I. C. M. R. Reports, 1953–56.

rest and later twine round a tree probably to crush the bones of the victim. A Boa constrictor can hold even a panther or a stag in this state and kill it. The jaws of a snake are not ankylised and it can open its mouth upto an angle of one hundred and eighty degrees. Similarly the mandibles are united in front by an elastic ligament. The forked tongue protrudes even when the mouth is closed. The victim is pressed in by the incurved teeth on the mandibles which prevent the escape of the bolus. If the victim is broad, the animal presses it lengthwise, just as a thick pack of coffee is pressed lengthwise and stored inside a long tin. A snake will not normally touch a prey already killed or lying dead. It prefers food killed by itself and may not normally eat even if the prey had been killed freshly by someone else. The tongue of the snake is an organ of smell and it constantly moves collecting scent particles. A rat snake not only coils round the victim but ties a bowline scout knot (*Figure 23*) by its tail end so that the coils remain tight. It also secretes some liquid giving foul odours.

A King Cobra is noted for feeding on other snakes. So also the banded krait *Bungarus fasciatus*. In fact in some of the villages of Madhya Pradesh, particularly in Chattisgarh Division, the farmers do not disturb this snake, locally known as " Ahiraj ", because it destroys other snakes and does not harm human beings or cattle. Cannibalism is quite common in snakes. We have seen Russell's viper eating its own young ones and two young vipers swallowing each other to death (*Figure 50*). In a survey of Ratnagiri District in Maharashtra it was noted that the gut contents of Echis carinatus snakes predominated with parts of insects body, particularly Earwigs.[1] It was possible to rear these snakes on Earwigs and other insects. The gut contents also showed scorpions, millipedes, smaller snakes, frogs, lizards and young mice. Lastly snakes have been seen to go on fast, many a time in captivity. We have seen a rat snake not taking any food for six months and a python for eight months. It took quite an amount of coaxing to feed them after this fast.

[1] I. C. M. R. Technical Report, 1953–56.

Jewels

There is a belief in many places that some snakes have jewels on their heads which illuminate the place when snakes go in search of a prey. We have seen some "jewels", said to have been recovered from snakes. They were not giving any light. The jewels were supposed to neutralise snake venom and suck out the poison. None of these properties were seen by us. At best the so-called jewels that we received were some tissues that had been kept well polished and preserved in coloured turmeric or *Kumkum* probably to keep it dry (*Figure 24*).

Ear

Snakes do not have an external ear opening like mammals. Neither do they have any ear cavity, eustachian tubes or a definite tympanum or drum. Except for the eyes, mouth, nasal opening and a pit in certain cases there is no other opening on the head. As the eyes have no eye-lids, they look open all the time, there are legends built up that the snakes hear by eyes and the Sanskrit word *chakshushrawa* has been coined for this purpose (hearing by eyes).

The actual auditory apparatus consists as in a cobra of a small semicartilagenous bone called columella auris, which in fact corresponds to the stapes in mammals. This is seen similarly in Echis (*Figure 19-E*). In this primitive condition, *i.e.*, the absence of the proper internal auditory apparatus or external ear, it is believed that snakes do not perceive sound as mammals do. Snakes, on the contrary, are very sensitive to the minutest tremors received through the ground or any other substratum. In our experiments with a cobra inside a tin box, it was noticed that playing of fine mild tunes of music near the tins had no effect on the snake. On the contrary any blaring sound that impinged heavily on the tin, made the cobra raise its hood. Similarly mild music played near the snake basket had little effect. One snake charmer was taken inside our snake farm and made to play his routine gourd music which is supposed to attract snakes. There was no response and no snake came out. It was only when he blared the gourd noise on the dealwood substratum that the cobra inside raised its hood. Similarly, merely playing the gourd music did not make the cobra

shake its hood. It was when the charmer moved his flute and hand that the cobra swayed with the specific purpose of getting an aim to attack and it did try to strike once or twice. It thus seems that the cobra sways to the swaying hands and the movement of the flute. (*Figure 2.*)

The stapes bone which is a relic of the past ear bones in snakes, is connected to the quadrate bone of the skull in the Indian cobra. It is likely that sound waves impinging on the substratum may be perceived by the lower jaw as vibrations and transmitted. The question then arises as to whether the cobra can further perceive the vibrations once it has raised the hood. In our experiments we found that once the hood had been raised, the snake was more sensitive to movements rather than to sound waves. Tumarkin also mentions in his theory that snakes perceive sound as substratum vibrations.[1] Bellairs and Underwood give similar views.[2] In India in rural areas it is a practice that villagers, while moving at night, carry split bamboo sticks and go on making a noise which conveys the vibrations on the ground and the approaching sound warns the snakes which may probably move away. It is quite likely that wooden sandles and even tinkling bells on legs and on cattle neck may give out such warning vibrations of approach which may cause the snake to move away.

The forked tongue

The tongue of a snake is forked. It is delicate and it often sticks out of the mouth even when the latter is kept closed. As has been mentioned before, the lower jaw of a snake is not a complete bone. In front, it is joined by a cartilage leaving some space in the centre. Through this the tongue often sticks out. The tongue is not used as an organ helping the intake of food. It is primarily an organ of sense. When a snake is lying still, well hidden in the surroundings, when the eyes without the eye-lids also remain still, it is only the movement of the tongue that gives out the presence of a snake. The reptile using the tongue tries to find out whether there is any danger in the vicinity before moving ahead. The tongue

[1] Tumarkin (1955).
[2] Bellairs and Underwood (1950).

consists of two cylindrical finely tipped organs joined at the base. They are so situated that they can stick out even when the snake is taking in its prey. This organ is variously coloured in different snakes, but it is primarily an organ helping the olfactory senses. When an *Echis carinatus* moves, the tongue is stuck out tips apart. If there is any danger the frequency of the movement of the tongue is very quick. In fact at such times it looks as if the snake is spitting. In the initial movements the two arms are apart sideways, but later they come nearer. The frequency of sticking out a tongue is reduced markedly as the snake is about to strike. In the case of a cobra also the flickering of the tongue is very active before raising the hood, and when the hood is about to come down. But when the snake is agitated and standing erect to strike, the frequency of movement is markedly reduced.

It is believed that the tongue collects scent particles from the air and while the tongue is withdrawn, transfers them to a structure called Jacobson's organ (*Figure 27-G*) for perception. A cobra may smell the approach of a mouse by its movement. Snakes breathe much less frequently than warm blooded animals. The approach of this mammal scent, and its movement has to be properly perceived. The tongue then quivers, comes out, spreads wide apart, collects the scent particles and goes on transferring them quickly to the Jacobson's organ for quick perception. The tongue therefore helps the sense of this smell perception to the normal organ, *i.e.*, nose.

The tongue is therefore an organ to help the olfactory sense, facilitating the snake in its search for food, the opposite sex and getting the scent of enemies in times of danger.

Eyes

The eyes of snakes have no eye-lids. They normally appear to be open all the time. When the snake is on skin, the eyes are seen to be covered with an opaque covering. At such periods, the snake is not able to see things. Once the skin has been cast off, the snake is restored to normal sight.

The eyes of the snake have a round or an elliptical pupil. Those snakes that move in the day-time or see during day-time, normally have an elliptical pupil. The noctural snakes have a round pupil

The pupils are capable of slight adjustment by constriction or expansion. Wall mentions that snakes " do not have a retinal centre of high sensitivity, hence there is no fixation or precise aiming of the eye at objects. In most snakes the eye sockets are so far back on the sides of the head that the range of possible stereoscopic vision is limited to a very narrow field directly in front of the snake ".[1] The snake's eyes have the capacity to narrow the pupils in the face of a strong light. When a snake is supposed to be resting or sleeping, it more or less closes the iris to the minimum, leaving only a thin opening of the pupil. When disturbed by a beam of light focussed on the eye, this opening widens.

The eye-balls have a small range of horizontal rotation. The two eye-balls can rotate independently. The snake's eye also has a hard transparent lens-like covering called the brille, which is a valuable protection to the eye and may have some optical effects. This brille or spectacle is shed periodically.

There is a difference seen in the cells of the retina of diurnal and other snakes. This pertains to the suppression of single or double cones in favour of rods. There are different colour pigments also in this region. The iris colour in many snakes more or less matches with the surrounding colour pattern of the head of that particular snake.

Wall mentions of eye-shine in some snakes like some kind of phosphorescence.[2] But many workers think that this is only a reflection on the spectacle. It is doubtful whether the snake appreciates different colour patterns.

The function of the eye in the case of snakes seem to be to guide them towards food, the opposite sex and give them a chance for protection and defence. The range of vision is limited. It is confined only to a very close range and is more active on a moving object. It is also believed that a snake may see by individual eyes but it is doubtful whether they have any stereoscopic vision.

Experiments carried out have revealed that a cobra during day time made six attempts at an inch thick stick held only

[1] Wall (1942).
[2] Wall (1938).

two feet from its head. These attempts were made more frequently when the stick was slowly moved and the snake wanted to take an aim. On the stationary stick the snake did not strike, unless other objects moved or something disturbed it. These experiments give an answer to the phenomenon of swaying its head to the gourd piper, only when the gourd is moved or the charmer makes some movement.

Snakes therefore get only a general impression of the habitat and they may not get a proper sharp image of any definite material.[1]

Touch

Even though snakes have no appendages and in spite of covering scales, they are very sensitive to minute sense of tremor or contact. A slight touch by a fine string or a few particles of soil falling on the body brings the snake to alertness. It has also been observed that they have certain sense to adjudge these sensations and translate them into actions for aggression or otherwise. A cobra if properly handled does not seem to strike. We have noted that a gentle and slight touch in a tender way does not arouse a cobra, while trembling fingers and a squeezing touch immediately makes it react aggressively.

A snake has no proper distinctive vision to get an accurate image of the object. The tongue is a tactile organ to receive particles for perception. The pits in many snakes are also useful in this respect.

A number of snakes give out some odoriferous secretions. A rat snake (*Ptyas mucosus*) emits a fairly foul smell and on touching this snake, this smell is often left behind on the hand. A krait (*Bungarus caeruleus*) emits a black secretion from the anal glands during certain months. This secretion also has some odour. A large number of female snakes secrete glandular discharges from the post-anal glands. The males of many snakes seem to be attracted during certain months to the females, probably due to this smell. It can then be surmised that a snake can follow the smell by its quivering tongue from a distance to the object. There is therefore some fictitious truth that a snake can follow a human being to take a revenge.

[1] Klauber (1956, p. 359).

It may probably be due to some smell emanating from the human body. But how far it can follow and on what surface it is doubtful. The belief that a snake has taken revenge may be purely coincidental. However, Meek (1946) mentions of an incident in which a diamond-back viper had no difficulty in selecting for attack, from a ring of men surrounding it, the particular individual who had traitorously divulged its hiding place to another.

Snake intelligence is probably confined to its motive in life, *i.e.*, hunting for food, mate and protection. Among Indian snakes a slimmer snake like the cobra seems to be more intelligent than the fatter ones, *e.g.*, a python.

A snake in laboratory has been able to react to material that brings food than otherwise. A snake in nature has been seen to react by concealment or exhibit aggressiveness to an intruder. A snake used to certain smell of the charmer who feeds it will react differently to other handlers. Like other animals of nature, it has got to be careful about strangers and react by hiding or a violent mode of protection or by adopting other definite tactics. Gentle handling or quivering hands make the snake perceive the difference for appropriate reaction. However, it may clearly be stated here that one cannot take for granted a typical method of handling to be perfectly repeated day in and day out for a snake to react appropriately. It is only in such cases that handlers get bitten due to some small lapses in their own behaviour and handling pattern. It is for this reason that handling should be restricted or done with proper protection. We have personally seen cobra snakes with intact fangs being carefully handled. These snakes and others have been put round the neck of the late Shri Jawaharlal Nehru by Shri Pachalegaonkar Maharaj.[1] (*Figure 25.*)

The pit in vipers

In the green bamboo pit viper, there is a depression on the loreal scale near the nasal opening. This pit is found in a number of snakes belonging to the family viperidae. In pythons also, there are small pits on the upper lips. The famous experiments of

[1] A photograph showing late Shri Nehru with a Krait round his neck appears opposite page 104 in the book *Bharatiya Samasthi Dharma.*

Nobel and Schmidt have shown that these are thermoreceptors.[1] Any variation in temperature is perceived by this organ in the pit (*Figure 26*).

The morphology of a typical snake, *Echis carinatus* has been worked out by Vad.[2] Some systems from these are given below.

The Digestive system (*Figure 27*)

Mouth cavity in *Echis carinatus* is bounded by the upper jaw and the lower jaw. On the roof, internal nares open in the front. Behind this is a small depression accommodating the glottis. By the sides of the nares are the fangs covered by fleshy sheaths. Between these are the palatine teeth. Below these are pterygoid teeth. Retractile bifid tongue lies in a sheath in the middle of the mouth. It is supported by an hyoid apparatus having an elongated cartilaginous arm.

Each venom gland lies on either side of the upper jaw below the orbit. Anteriorly it narrows to form the venom duct. At the anterior end it forms an ampulla like structure before opening at the base of the fangs. The fangs are backwardly directed maxillary teeth. Longitudinal section of a fang shows a hollow tube and at the base of this tube open the ducts of venom glands.

Buccal cavity leads to the pharynx which is shorter and a little broader than the oesophagus. The entire alimentary canal from here onwards lies to the left hand side of the body cavity. Oesophagus is thin walled and runs into the dilated stomach which is also thin walled and has internal longitudinal muscular ridges. The distal portion of the stomach is narrower and is marked by the pyloric valve with transverse muscular bands. After the pyloric valve lies the intestine, the upper portion of which forms a duodenum, where the pancreatic and cystic ducts open. The first portion is the small intestine which is coiled and the posterior portion is straight which finally leads into a dilated rectum. The rectum often contains undigested food and opens into a cloaca which is covered by an anal plate. Excreta when semi-solid looks grey and partly black.

[1] Schmidt (1937).
[2] Vad (1959).

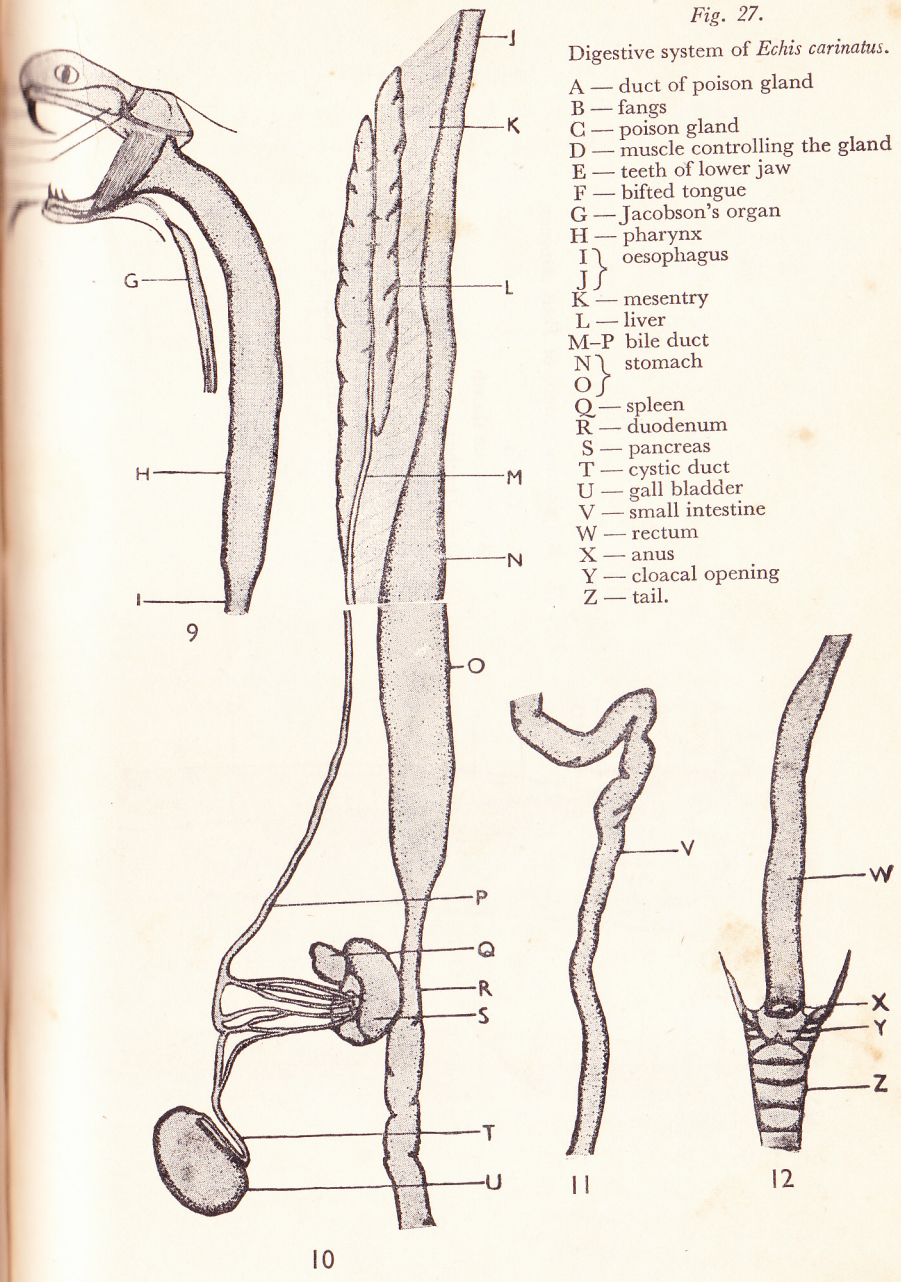


Fig. 27.

Digestive system of *Echis carinatus*.

A — duct of poison gland
B — fangs
C — poison gland
D — muscle controlling the gland
E — teeth of lower jaw
F — bifted tongue
G — Jacobson's organ
H — pharynx
I, J } oesophagus
K — mesentry
L — liver
M–P bile duct
N, O } stomach
Q — spleen
R — duodenum
S — pancreas
T — cystic duct
U — gall bladder
V — small intestine
W — rectum
X — anus
Y — cloacal opening
Z — tail.

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Mouth cavity in *Echis carinatus* is bounded by the upper jaw and the lower jaw. On the roof, internal nares open in the front. Behind this is a small depression accommodating the glottis. By the sides of the nares are the fangs covered by fleshy sheaths. Between these are the palatine teeth. Below these are pterygoid teeth. Retractile bifid tongue lies in a sheath in the middle of the mouth. It is supported by an hyoid apparatus having an elongated cartilaginous arm.

Each venom gland lies on either side of the upper jaw below the orbit. Anteriorly it narrows to form the venom duct. At the anterior end it forms an ampulla like structure before opening at the base of the fangs. The fangs are backwardly directed maxillary teeth. Longitudinal section of a fang shows a hollow tube and at the base of this tube open the ducts of venom glands.

Buccal cavity leads to the pharynx which is shorter and a little broader than the oesophagus. The entire alimentary canal from here onwards lies to the left hand side of the body cavity. Oesophagus is thin walled and runs into the dilated stomach which is also thin walled and has internal longitudinal muscular ridges. The distal portion of the stomach is narrower and is marked by the pyloric valve with transverse muscular bands. After the pyloric valve lies the intestine, the upper portion of which forms a duodenum, where the pancreatic and cystic ducts open. The first portion is the small intestine which is coiled and the posterior portion is straight which finally leads into a dilated rectum. The rectum often contains undigested food and opens into a cloaca which is covered by an anal plate. Excreta when semi-solid looks grey and partly black.

[1] Schmidt (1937).
[2] Vad (1959).

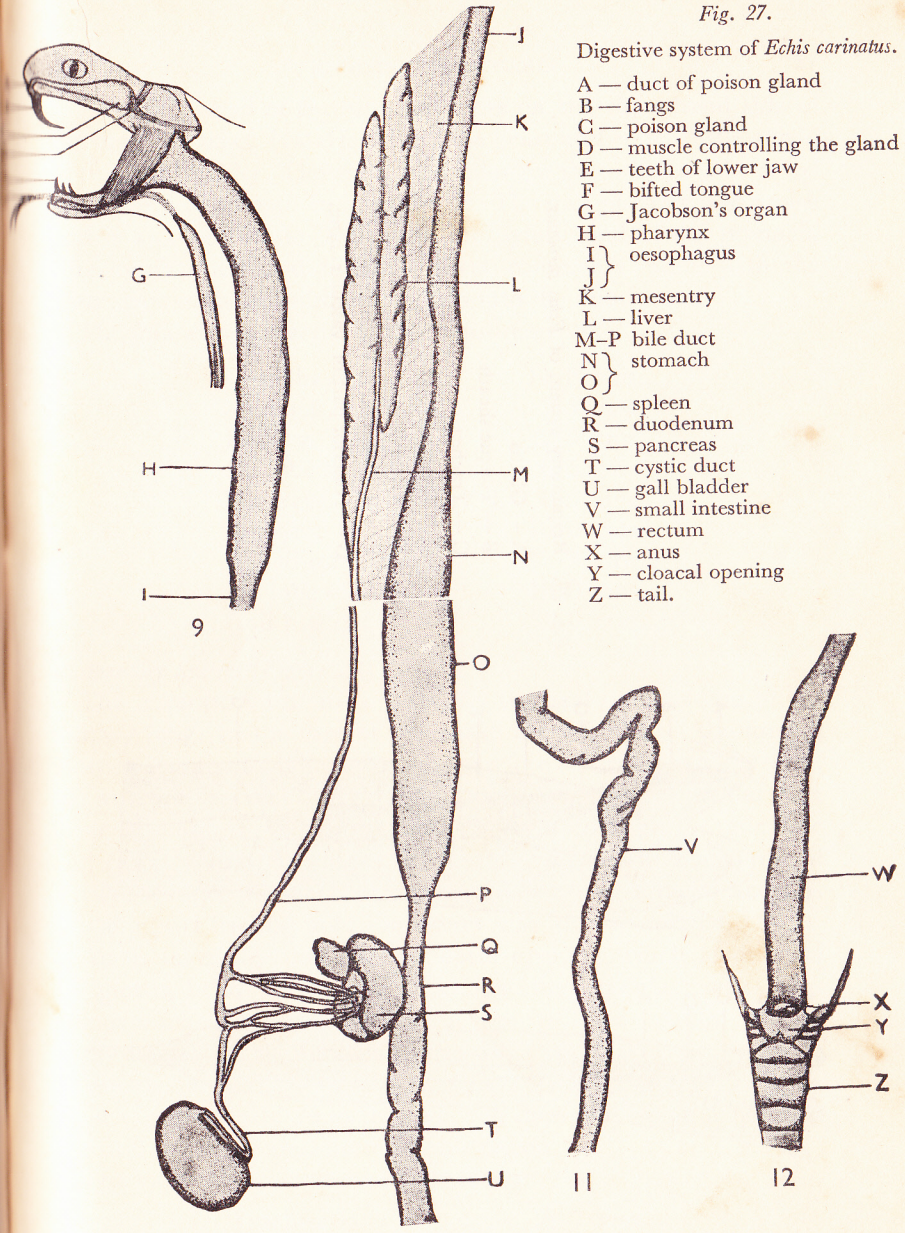


Fig. 27.

Digestive system of *Echis carinatus*.

A — duct of poison gland
B — fangs
C — poison gland
D — muscle controlling the gland
E — teeth of lower jaw
F — bifted tongue
G — Jacobson's organ
H — pharynx
I, J — oesophagus
K — mesentry
L — liver
M–P bile duct
N, O — stomach
Q — spleen
R — duodenum
S — pancreas
T — cystic duct
U — gall bladder
V — small intestine
W — rectum
X — anus
Y — cloacal opening
Z — tail.

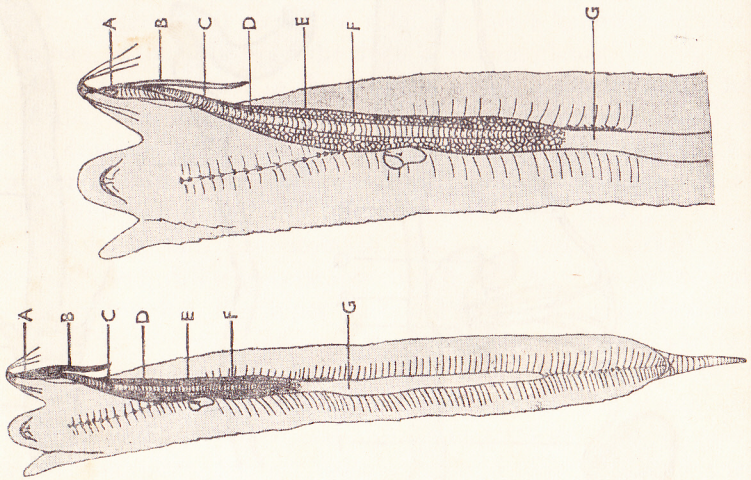


Fig. 28. Respiratory system of *Echis carnatus*.

A — Glottis
B — Tongue sheath
C — Trachea
D — Tracheal rings
E — Vascular lung
F — Reticulation of vascular lung
G — Posterior part of vascular lung.

Liver is formed of two unequal lobes on the right hand side of the digestive tract. It starts behind the heart and ends a little ahead of the gall bladder. The right lobe is longer than the left. It is red in colour and smooth in appearance. The gall bladder is greenish and is attached to the liver near the pyloric end of the stomach. The cystic ducts and the bile ducts commonly unite with the pancreatic mass and ultimately open into the duodenum.

The following are some of the measurements:

Oesophagus	11·0 cms.
Stomach	7·3 cms.
Rectum	2·5 cms.
Lt. lobe of liver	6·5 cms.
Pancreas	0·5 cms.
Pharynx	10·0 cms.
Coiled intestine	12·3 cms.
Rt. lobe of liver	18·0 cms.
Gall bladder	1·0 cms.

Respiratory System (*Figure 28*)

The respiratory system consists of a tracheal tube leading into a solitary lung. In the case of this snake the left lobe of the lung is more or less absent. The right lobe therefore consists of two portions, the anterior vascular and the posterior saccular. The vascular part is spongy and extends upto the heart. The saccular part is reticulate and extends upto the kidney. This later part acts as a reservoir of air. No wonder the viper seems to swell as it gets agitated and this saccular part leading upto the kidney gets heavily inflated.

Air is taken by the external nasal opening which leads upto the glottis, below the tongue. It leads to the muscular and cartilaginous tracheal tubes which later merge with the vascular portion of the lungs. Near the glottis the tracheal portion has heavy layers of muscles and this portion is often called a larynx. In some snakes, particularly *Ptyas mucosus*, one does find some kind of a guttural sound emanating from this region.

The following are some measurements:

Trachea	12·7 cms.
Vascular lung	7·0 cms.

Tracheal tube	3·5 cms.
Saccular lung	17·0 cms.

A non-poisonous snake like the python has two distinct lungs.

Urinogenital System (*Figure 29*) — (*Reproductive and Excretory*).

The kidney is narrow, strip-like and has a slight constriction. It is attached to the body wall dorsally by the folds of the peritoneum. From its outer sides, a white delicate duct ureter runs down posteriorly into the cloaca. Urinary bladder as a separate unit is absent.

In *Echis* snakes, sexes are separate. In the males, the testes are yellow, oblong bodies, the right lobe lying little anterior to the left. Each testis is attached to the body wall by the fold of the peritoneum. Adrenals are attached to the lower margins of the testes. Vas deferens starts from the anterior border of the testes and runs on the dorsal side to form the coiled epididymis. This is followed by the sperm duct that runs along the ureter to the common opening in the cloaca. Thus two openings at either side are situated in the cloaca. A small raised surface forming a papilla is situated at the openings of the cloaca. A pair of reversible copulatory organs—penis is present in the tail of the animal. Sex can be determined by pressing the tail from the tip towards the anus. In the cases of males two stumpy organs—penis, project out from either side of the lobes. These stumpy organs have longitudinal furrows (*Figure 30*) and transverse rings. Sperms are carried through these furrows at the time of the ejaculation and are taken to the tip of the lobes of the penis and along the canals on the ventral side and are deposited in the cloaca of the female during copulation. Tips of the lobes are round and blunt. Spine-like structures are present at the side of the penis.

In females the ovaries are elongated bodies with ridged surface and rounded elevations showing the presence of ova. Ovaries are situated at the same level as the testes in the males. The right side ovary is a little anterior to the left. Ovaries are also attached to the body wall by the folds of the peritoneum. Adrenals are attached to the lower outer margins of each of the ovary. The oviducts are thin-walled ducts, opening anteriorly at the level of the ovary by a

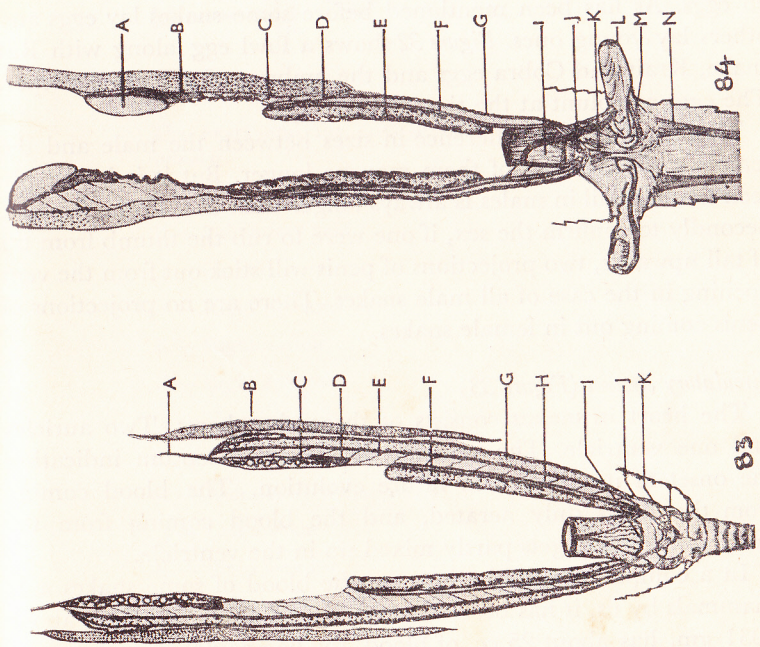
Fig. 29. Reproductive system of *Echis carinatus* (Urinogenital).

83 — Female

A — Ligament
B — Fat body
C — Ovary
D — Adrenal
E — Mesentry
F — Kidney
G — Oviduct
H — Ureter

84 — Male

A — Testis
B — Adrenal
C — Fat bodies
D — Vas deferens
E — Kidney
F — Ureter
G — Vas deferens
I — Rectum
J — Urinogenital opening
K — Cloacal muscles
L — Penis
M — Groove in Penis
N — Penis muscles.



funnel like opening. Oviducts posteriorly dilate to serve as a pouch for the developing embryos. The ureter and the uterine openings are separate representing four openings in the cloaca, instead of two openings as in the case of the males.

The viper produces from 40 to 75 young ones in about 3 days. On hatching out the young ones move out and cast their skin on the second day. Later on, the frequency of casting is lengthened. They do not feed for about 15 days, but later migrate for food. The eggs in other snakes are laid in soil and in some snakes like the King Cobra a nest of bamboo leaves is made and the female sits over the eggs. Pairing normally takes place in the rainy season. This is always done in a horizontal position. The eggs are laid next year during March to April. In the case of a cobra, it has been seen that the egg took about 58 days to hatch and the snake had laid about 55 eggs. As has been mentioned before some snakes lay eggs and others lay young ones. *Figure 32* shows a fowl egg along with Rat snake, Krait and Cobra eggs and the embryo of a Russell's viper. The eggs are blunt at the tips.

There is a distinct difference in sizes between the male and the female snakes. Either of them may be longer. But it is invariably seen that the tail in males is always longer than that in the females. Secondly to confirm the sex, if one were to rub the thumb from tip of tail upwards, two projections of penis will stick out from the vent opening in the case of all male snakes. There are no projections of penis coming out in female snakes.

Circulatory System (*Figure 33*)

The heart in snakes consists of three chambers: Two auricles and one ventricle. The ventricle has a small septum indicating the onset of its division in future evolution. The blood coming from the lungs duly aerated, and the blood coming from the body for aeration gets partly mixed up in the ventricle.

In a comparative study done on the blood of some snakes and mammals by us, it has been observed that a cobra weighing about 1031 gm. has about 25 cc. of blood, the haemoglobin content was about 8 to 10 gm., and the calcium content was 17 to 20·5 gm. for 100 cc. of blood serum. The value for a rabbit weighing 1670 gm.,

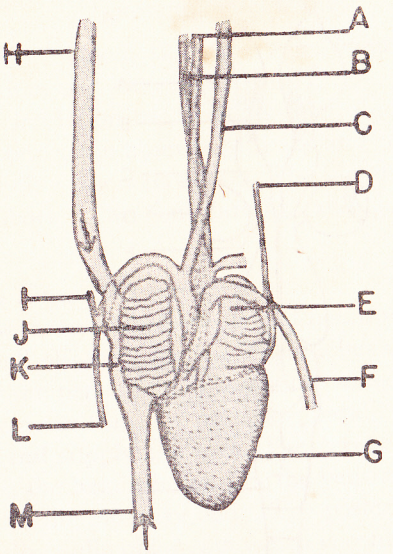


Fig. 33.

The heart and the circulatory system of *Echis carinatus*.

A — Pulmonary artery

B — Pulmonary vein

C — Carotid artery

D — Right precaval vein

E — Right auricle

F — Right systemic

G — Ventricle

H — Left precaval vein

I — Anterior vertebral artery

J — Left auricle

K — Sinus venosus

L — Left systemic

M — Post caval.

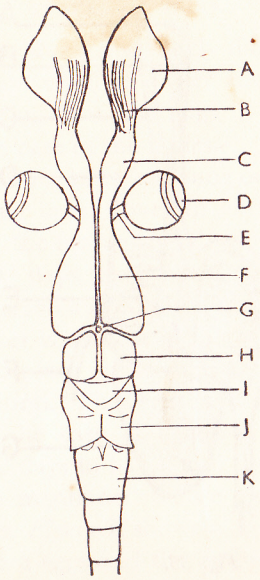


Fig. 34. Nervous system of *Echis carinatus.*

A — Olfactory capsule

B — Olfactory nerve

C — Olfactory lobes

D — Eye

E — Optic nerve

F — Cerebral hemisphere

G — Pineal body

H — Optic lobes

I — Cerebrum

J — Medulla oblongata

K — Spinal cord.

was 50 cc. of total blood, 12 to 16·2 gm. haemoglobin and 10 to 15 gm. of calcium per 100 cc. of serum.

The blood circulation has been modified due to the compressed nature of the body, the absence of limbs and the reduction of one lung especially in poisonous snakes. The blood vessels to the limbs have been aborted, as the carotid, and jugular has become asymmetrical.

Nervous System (Figure 34)

This consists of two lobes of cerebral hemispheres which in front carry two small olfactory bodies. These lobes send olfactory nerves anteriorly for the perception of sensations allied to smell. Ventrally optic nerves emerge from the posterior basal region of the cerebral hemispheres and supply the eyes. The cerebellum is a triangular region behind the hemispheres. On the ventral side lies the pineal and ahead of it the pituitary body. The posterior part of the brain consists of the medulla oblongata which is continued into the spinal cord. The body temperature of the snakes is more or less in keeping with the (98°F) temperature of their surroundings. They go in for hibernation in winter months and wake up at the onset of spring.

In winter many a snake that are exposed to cold get frozen. Similarly if a cobra is exposed to hot sun even for one hour, it will die. *Echis carinatus* on the contrary can stand the heat of the rock and sand better.

Movement

Swimming: All snakes can swim. But the capacity to swim for longer periods and stay long in water is confined to water snakes. The body of these snakes is modified in a way that the ventral scales are reduced in size and the tail is flattened to form a structure like an oar (*Figure 35-b*). We have seen snakes dipping inside ponds and remain submerged for about ten minutes at a time without coming up for respiration.

Swimming is done by keeping the head, particularly the anterior portion with the nasal opening above water and the progression is made by the undulating motions by the body.

Climbing: The Rat snake (*Ptyas mucosus*) or the green whip snake (*Dryophis nasutus*) or *Chrysopelea ornata* have been seen to climb

trees in a short time. They seem to be very agile and the climbing is done by the undulatory motions of the body and the forward thrust. The ventral scales probably try to grip the surface along with the tail which goes on twining round the objects. In fact a rat snake is capable of tying a knot round any vertical object and exert a pull at it (*Figure 23*).

Crawling: The movement on land is brought about by four roughly defined techniques.

(1) *Horizontal undulatory progression*

This can be compared to the lashing of the body from side to side into a longitudinal motion. This motion may be brought about in a series of side waves gliding smoothly along, and each part of the body definitely following the wavy path first taken by the head and the neck. The straightening and shrinking of the body at the spots where the curvature decreases and increases is brought about by the musculature inside the body. This increase and decrease in the curvature at spots where the snake encounters resistance may be compared to a pivot for the curve. This method of progression is normally met with on rough surfaces negotiated by the snakes.

(2) *Rectilinear Progression*

This method of progress is more useful for the thick bulky bodied snakes like Boas and Vipers. In this method the ventrals are pressed against a hard surface and the body is slid forward within the skin, pulled by the appropriate muscles. As the inside body goes forward the ventrals loose the hold and take the hold further on and this process continues from neck to tail. The points of contact in the length would be many, but the motion is like a wave and is more intense in the middle of the body. The direction of movement is in a straight line though the undulations are sideways. The snake can adopt this method to go back and forward.

(3) *Side Winding*

This method of progression is seen more in snakes having the ecological conditions of a sandy desert. In India *Echis carinatus*

is the snake which typifies this method of motion. It is also adopted to some extent by snakes negotiating a smooth surface. Here the head and the neck get an anchor on the substratum. Often the head remains partly raised and poised for the strike. However, as the head and the neck are anchored, the body moves forward at a 30 degree angle from the line of progression of the head. The head is then removed and put at other point of anchor at the other side and the body again moves at a 30 degree angle. Thus the body is partly moved in advance of the anchorage. There are no transverse but only vertical forces that are applied to the track, wherein each section has the same length as that of the snake.

Just as a human foot without shoes can negotiate better than a wheel in a desert sand by taking an anchorage or grip and then putting forward the next step for another grip, so does an *Echis carinatus* snake negotiate in the loose sand for progression. The method is called side winding, because if a line is drawn from head to tail, the axis of progression would be perpendicular to this line in the shape of letter ' S '.

This method is used when the surface is smooth or when the snake is taking a slow hesitating motion while stalking a victim. The speed attained by this motion is about two miles per hour.

(4) *Concertina progression*

Some scientists call it an earthworm type of movement. In this method, the central part of the body is gathered into a couple of curves and then they are straightened. While this is being done, the head is anchored so that the tail end comes nearer and forward. The process is repeated as curves are formed and the tail is anchored so that the head and neck are thrust forward. With each complete cycle the snake advances by the difference between the lengths of the snake.

This method may not be the normal motion in snakes, but is adopted when the snake is not willing to give out its presence and is investigating an object slowly. This method also gives the snake a chance to hide itself in the natural surroundings due to its camouflaged skin, as part of its body always remains stationary.

As it is not subject to a lateral motion, the head can concentrate on any object for a strike. Lastly on a smooth surface and with restriction of side walls this method may be useful as compared to the rectilinear progression.

Speed: The side winder has been seen to do about two miles an hour and probably covers about 1,000 yards in a night prowling. Dr. Klauber quotes Hastings to mention that the speed of an African mamba may come to about 30 miles an hour.[1] This is doubtful. The snakes are cold-blooded animals. They do not have the cooling system like the sebaceous glands of mammals wherein they could sweat out. The heart is also three-chambered, so that the aeration of the blood may not take place in a proper manner. The body temperatures are also low. Considering these factors, it is likely that a snake may attain a speed for some very short periods in the form of darting, but it may not be in a position to keep it up.

The speeds of Indian snakes have not been worked out.

Longevity

Reptiles normally live long. The tortoises have been counted to have lived 500 years. In the case of snakes, laboratory experiments have shown them to live for a period of six years so far. In nature they may live at least five times more than this. No authentic records are available to know the longevity in the case of Indian snakes, except those in folklore and stories.

Rearing

Snakes cannot stand very high or very low temperatures. Normally they do not want to be in bright sunlight or under any glaring light. Except for certain species like *Echis*, a majority of snakes prefer tolerable amount of humidity. Lastly, snakes need peace and quietness.

If these conditions are given it is possible to rear snakes. There should be clean cool water in the area for drinking and some living food be given to it twice a week. The food may consist of

[1] Dr. Klauber (1956, p. 348).

small mice, frogs, or lizards. In the case of a python, a rabbit, pigeon or a fowl is needed per fortnight while the very small snakes like *Echis* could be reared on insects also. A number of snakes could be handled with ease and fed with minced meat to which has been added a dilute solution of Vitamin B Complex. If milk is to be given, it be made into a flip by adding an egg and the liquid poured into the mouth by a funnel. Care should be taken to prevent the funnel stem from hurting the oesophagus.

The snakes that could be reared as pets without harm are a few of the following:—

Natrix stolata, *Typhlops braminus*, *Eryx johnii*, *Python molurus* and *Ptyas mucosus*.

The cage should be such as to keep the excreta away from the resting area of the snake. Some dilute antihelminthic drugs given once in three months will keep the snakes free from worms. The major ailments to be avoided are mouth infection and partial casting of skin.

The description and running of a snake farm are given by Deoras.[1]

Snakes could be easily handled. Snakes like the Cobra, *i.e.*, those with canalised fangs, are lifted by the tail, keeping the head away. The head is then pinned, caught between the thumb and the index finger, and the snake is held thus with the tail in the other hand. The big fanged Russel's viper is pinned at the head, caught by the thumb and the index finger and then held up. The release of a snake is done by holding it in a bunch and very quickly throwing the lot in the cage and simultaneously closing the door of the cage.

[1] Deoras (1963).

Chapter IV

CLASSIFICATION AND IDENTIFICATION OF SNAKES

THE broad distinguishing features about knowing a snake are given in Chapter III. In the present Chapter are enumerated some simple points to distinguish broadly the group of poisonous snakes from that of non-poisonous ones. It also gives a list taken from Smith of the names of different snakes found in India and their probable distribution.[1]

There are about 216 species of snakes recorded in Indian Union by Smith.[2] Table No. I groups these species into poisonous and non-poisonous ones. It will thus be noted that there are more non-poisonous snakes.

The Indian snakes have been grouped into a number of families. Table No. II classifies the different families by simple characteristics to enable the readers to know a poisonous from a non-poisonous family. There are a number of species of snakes under each of these families available in India. Table No. III gives only a list of these different species arranged under each family. There is also an indication of the distribution recorded for these species in India. Thirty-six species from this lot have been taken and some details of these are given in this Chapter.

Ecological Distribution

The body of the snake is often modified to suit its ecological conditions. These are particularly noticed in burrowers, swimmers, arborials and terrestrials. Many snakes could be spotted for identification by these habitats.

The burrowing snake shuns light. The majority of them, rather all of them, are non-poisonous. These snakes are either blind or have very small eyes and the scales are imbricate or are not well defined

[1] Smith (1943).
[2] *Ibid.*

The tail is rather blunt and many a time it has either a spine or roughness which may be used for burrowing purposes. The colouration in these snakes is either dull and they may have spots for camouflage. They live on decaying matter, earthworms, insects, lizards and frogs. To this group belong the blind snakes, *Typhlops braminus*, *Uropeltis ocellatus* and sand boas like *Eryx conicus* and *Eryx johnii*.

The swimmers are characterised by the flattening of the tail to form an oar-like organ. The front part of the head being raised the nostrils are placed at the very tip for breathing purposes. The ventral scales in sea snakes become completely compressed to form just a ridge (*Figure 35*) at the base, giving the snake more chance for counteracting resistance in the sea. This is more prominent in sea snakes than in fresh water ones. The former are invariably poisonous, while the latter are non-poisonous. To the group of sea snakes belong *Chersyderus granulatus* and to the other *Cereberus rhynchops* which are nicely coloured. The scales on the head and the body are tiny as if divided into a number of parts. These snakes, particularly the sea snakes, are very uncomfortable when left on land and they try to wriggle back with the tide into the sea. Their movement on land is very sluggish and they cannot progress. They feed on frogs, fishes and mollusca.

The arborial snakes have an elongated tail and a supple body. The colouration is in tune with nature. The head is elongated and well defined scales are present on the head and the body. Their food consists mostly of birds and lizards. These snakes are mostly non-poisonous. The parrot green whip snake, *Dryophis peroteti* remains perched on tree branches turning with the tail and keeping the head loosely suspended to imitate green tree twig. Even the rat snake, *Ptyas mucosus* with its long tail and capacity to tie a knot (*Figure 23*) is a good climber. We do not have the famous Mamba snake of Africa in our country. *Python reticulatus* is also a good climber, but very few authentic records of this snake are available in India. The green pit viper *Trimeresurus gramineus* is found on bamboo trees. It is a poisonous snake. The colour is leaf green and the head typically triangular as that of a viper.

The ground snakes have well developed scales on the head and body. The body scales are well defined into dorsal and ventral

and many of these scales have been modified into scutes, tubercles, serrations and spines. The body is developed for land progression, chemoreceptive organs are present, hissing and the capacity to raise a part of the body menacingly are well developed. Their main food is mammals, but they do take in frogs, slugs, insects, lizards, scorpions and snakes. In this group, the majority of non-poisonous snakes have a well developed strong muscular body and two lungs. The poisonous snakes have a smaller less musculated body, one of the lungs has either been reduced, atrophied or absent and there has been a development in the formation of special teeth, called fangs on the upper jaws. These fangs, unlike the teeth are specially developed to have a canal or a gutter and are replaceable when broken, by the development of new fangs from the buds at the sides of the fangs. The modified parotid gland pours its liquid as poison into the upper opening of this fang for transmission to the wound. This development is not seen in non-poisonous snakes.

To the category of non-poisonous ground snakes belong pythons, trinket snakes, racer snakes, while to the poisonous group belong the Cobra, Krait, Russell's viper and Saw-scaled vipers.

Many details of classification of snakes are based on the scales present on the body and the head of the snake. These scales have particularly been modified into special characteristics which for identification are called shields. These shields are most prominent on the head and the upper and the lower sides of the snake's body.

The scales on the body of snakes thus form a good distinguishing feature to identify a number of them. These have been enumerated below. At the end are given broad descriptions of 36 common snakes of India with their pictures wherever available.

At the outset it must be clearly borne in mind that scales are the external covering of a reptile. The blind snakes which are primitive have imbricate scales (semi-circular) all over the body and their two ends are blunt. They could be distinguished from an earthworm by the absence of lines of segmentation and the presence of these scales; apart from teeth, tongue, bones and other characteristics. The higher evolved snakes have well defined and designed scales on the head and on dorsal and ventral surfaces of the body. The

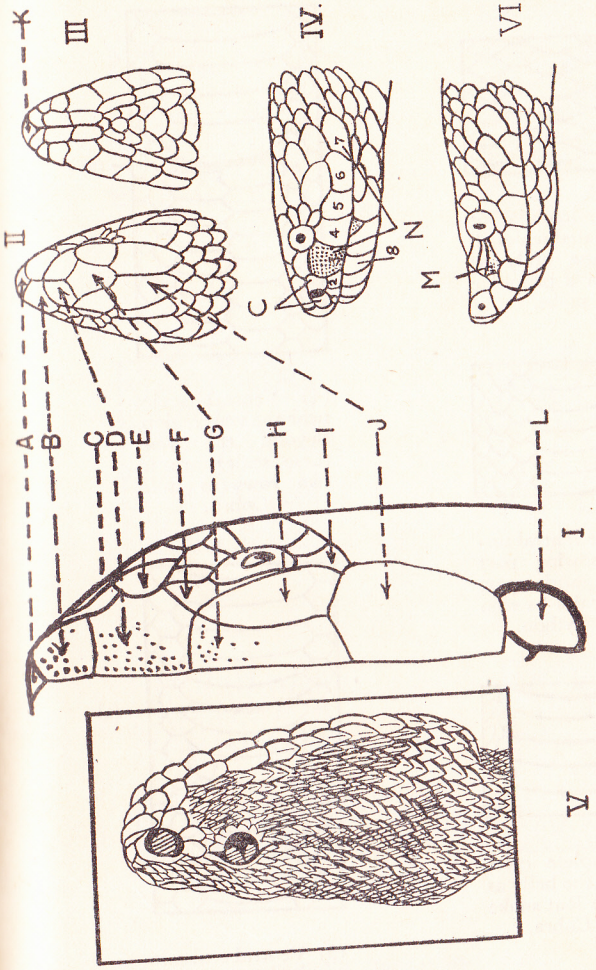


Fig. 36. Names of different head scales in a snake.

I. Enlarged drawing of head scales.

A — Rostral
B — Internasal
C — Nasal
D — Prefrontal
E — Loreal
F — Preocular
G — Frontal
H — Supraocular
I — Postocular
J — Parietal
K — Mental
L — Occipital
M — Pit
N — Supralabial.
8 — Infralabial

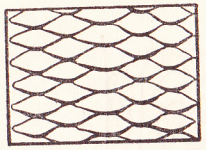
II. Head scales in different view.

III. Head scales seen ventrally.

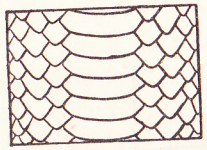
IV. Cobra head, showing third supralabial touching the nasal and eye and a triangular shaded wedge between fourth and fifth infralabial and three postoculars.

V. The small scales on the triangular head of a Russell's viper.

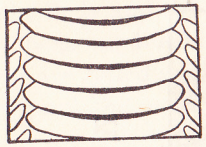
VI. Showing the pit in a pit viper.



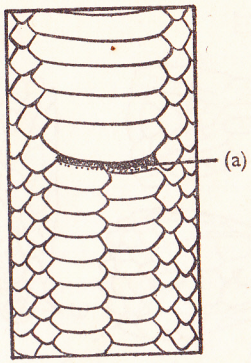
(1) Semicircular or imbricated scales all over the body as seen in a primitive snake.



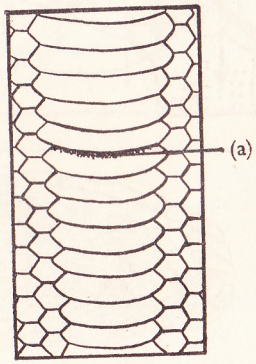
(2) The ventral surface showing part across and part small scales as seen in a Python.



(3) Complete cross scales on the belly as seen in a Rat snake or a Cobra.



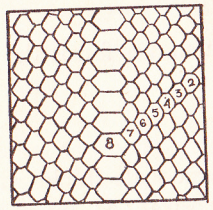
(4) Ventral scales near the vent region. Beyond the vent these scales are in two rows as in a Cobra.



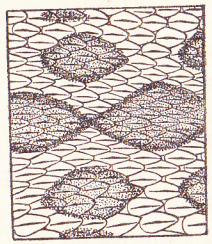
(5) Ventral scales in a single row even beyond the vent as seen in a Krait.

(*a*) Vent.

Fig. 37. Belly Scales.



(1)



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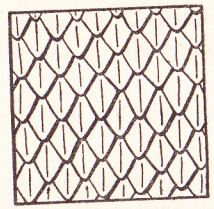

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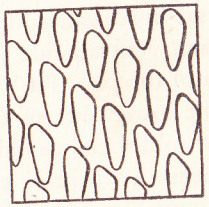

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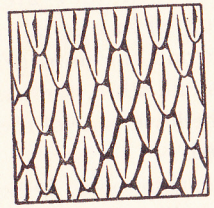

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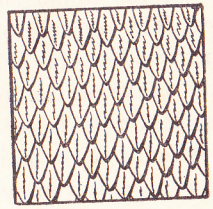


(6)

Fig. 38. Scales on the upper (dorsal) side.

(1) Central row of dorsal scales, big and hexagonal as seen in a Krait.

(2) Oblong scales with a line as seen in a rat snake, as compared to (5) rhomboid scales with space in between as seen in a Cobra.

(3) and (4) Scales in a Russell's viper. Semi-eliptical with a thin line in the centre (6) overlapping elliptical scales with serrated lines like a saw seen behind the head in *Echis carinatus*.

variation in these scales seen in different snakes forms the basis of identification.

Identification by Scales

Primarily the head consists of certain basic scale shields enumerated at (*Figure 36*). These are named as rostral (A), internasal (B), nasal (C), prefrontal (D), loreal (E), preocular (F), frontal (G), supraocular (H), postocular (I), parietal (J), mental (K), occipital (L), pit (M), supralabial (N), and infralabial (8).

In the picture one can see the large size line drawing showing the dorsal head scales along with the small size drawings showing the dorsal, ventral, side view of snake heads giving the scales and the area of the pit. (Pit VI-M).

On the lower side of the head are the anterior sublingual and posterior sublingual shields.

The head in a primitive snake does not show these differentiation in scalation. Similarly in a sand boa and vipers the head scales are very small and not differentiated.

On the body of the snakes are scales designated as dorsal when they are on the upper side and ventral when they are on the lower side. The number of scales are counted in a serial row from below to the other end (*Figure 38–1*). Beyond the anus (*Figure 37–4/a*) of the snake on the lower side is a small scale, the *anal*. After this the scales on the lower side, *i.e.*, on the lower side of the tail are caudals, which may be paired or unpaired.

The dorsal scales may be elliptical, rhomboid, keeled, with tubercles or serrated. In primitive snakes like Typhlops they are imbricate, *i.e.*, semi-circular. The ventral scales may not be reaching completely the two ends of the belly or they may be complete.

Based on the differences in the scalation, the following table is laid out for the identification of non-poisonous and poisonous snakes.

IDENTIFICATION OF NON-POISONOUS FROM POISONOUS SNAKES

Non-Poisonous

1. Scales on the body imbricate, *i.e.*, semi-circular (*Figure 37-1*)
   No proper distinction between dorsal and ventral scales.
   Tail blunt .. .. — **Typhlopidae** Blind snakes

2. Scales on the body clear, the ventral scales running across the belly.
   (*a*) Ventral scales not completely across the belly (*Figure 37-2*). Eyes present. — **Uropeltidae** *Uropeltis ocellatus*
      (*i*) Tail end blunt (*Figure 35-a*), rough tails .. .. .. — **Boidae** Sand boas
      (*ii*) Tail end blunt but not rough (*Figure 35-d*) .. .. .. — *Eryx conicus* *Eryx johnii*
      (*iii*) Tail elongate with spurs near anus .. .. .. — *Python molurus*
   (*b*) Ventral scales completely across the belly (*Figure 37-3*). Nostrils usually lateral, head covered with large symmetrical shields. Hypophyses absent or present on the posterior dorsal vertebrate. Teeth solid .. .. — **Colubridae** All Colubridæ snakes
   (*c*) Ventral scales completely across the belly. Head shields present in which loreal may be absent. Tail cylindrical except in sea snakes. Hypophyses developed throughout the vertebral column. Few teeth modified to form fangs followed by solid teeth .. .. — **Elapidae, Hydrophiidae and Viperidae** (*see* 3 *below*)

Poisonous

3. (Those in 2*c*)
   (*a*) Ventral scales not completely across the belly. Tail flattened or modified to form an oar-like

(*Figure 35–b-c*) structure. The ventral scales modified (*Figure 35–c*) to form ventral ridge. Eyes at the anterior most end of head. Poison fangs present .. .. .. **Hydrophidae**
Hydrophis mammillaris

(*b*) Ventral scales completely across the belly. Tail elongate. Head shields well developed. Head oblong or elongate. Poison fangs small in front of jaw, not erectile and not covered by a sheath .. **Elapidae**

(*i*) Central row of dorsal scales hexagonal (*Figure 38–1*) and caudal scales in a single row (*Figure 37–5*). Body steel blue with white cross bars or white cross spots .. .. .. Common Krait
Bungarus cœruleus

Body yellow with black cross bands and a black stripe across the face .. .. Banded Krait
Bungarus fasciatus

(*ii*) Central row of dorsal scales of the same type, rhomboid or elliptical and with some distance in between them. Head not triangular. Head shields well developed. Fangs neither erectile nor covered by a sheath.

(*iii*) Hood present. Eyes with a round pupil. Frontal shield truncate. Three small postocular scales behind the eye. Seven supralabials of which third is biggest and is touching

the eye and the nasal scale. A tiny triangular shield between fourth and fifth infralabials (*Figure 36–IV*). The caudal scales in pairs (*Figure 37–4*). Apart from the binocellate or monocellate mark on the hood, two or three series of black bands on the ventral surface of the hood between 10th and 17th series of transverse scales. Between 15th and 30th ventral scales a pair of round black mark extending from 4 to 6 scales Cobra
Naja naja

(*iv*) Frontal shield not truncate anteriorly. No triangular shield between fourth and fifth infralabials. The presence of two large occipital shields (*Figure 36–L*) beyond parietal. Caudal scales near vent are single and beyond are divided. Poison fangs present. Hood with yellow cross bars dorsally and two black bands and corner black spots ventrally. Body oliveceous along and with cross banks .. .. King Cobra
Naja hanna

(*v*) Hood absent. Body slender. Two postocular. Six supralabials third and fourth touching the eye. Three or four teeth behind the poison fangs. Small snakes, light brown or

reddish with black spots or stripes even on the head .. Coral snake *Callophis melanurus* (*Figure 39*)

(*c*) Ventral scales across the body. Tail elongate. Head shields tiny. Head triangular (*Figure 36–V*). Poison fangs big erectile, cannaliculate and covered by a sheath. Eyes with vertical pupils (*Figure 16*). **Viperidae**

(*i*) Dorsal body scales oblong with a central longitudinal (*Figure 38–3*) ridge and with three rows of elliptical spots (*Figure 49*) on the body. Big size .. .. *Russell's viper*

(*ii*) Dorsal body scales at the sides serrated (*Figure 38–6*) (*Figure 14*). Head with an arrow (*Figure 46–a*) head mark. Body covered by brown rows of patches. Movement by side winding. The serrated scales make a continuous sound. Small snakes not more than 18 inches in length. Fangs erectile and covered by a sheath *Echis carinatus*

(*iii*) A pit beyond the nasal between preocular and loreal (*Figure 26*). Eyes with a vertical pupil. Scales on body keeled. Tip of head raised in the rostral region. Fangs erectile, covered by a sheath .. Pit Vipers

TABLE I

NUMBER OF SPECIES OF SNAKES IN THE INDIAN UNION

S. No.	*Family*	*Genera*	*Species*
Non-Poisonous			
1.	Typhlopidae	1	14
2.	Leptotyphlopidae	Not in Indian Union	
3.	Uropeltidae	6	33
4.	Anilidae	Not in Indian Union	
5.	Xenopeltidae	1	1
6.	Boidae	2	3
7.	Colubridae	34	112
8.	Dasypeltidae	1	1
		45	164
Poisonous			
9.	Elapidae	3	13
10.	Hydrophiidae	8	19
11.	Viperidae	5	20
		16	52
	Grand Total	61	216

TABLE II

CLASSIFICATION OF SNAKES UPTO FAMILIES

I. WORM LIKE BODY

Eyes vestigeal.

1. Entire body covered by uniform imbricate scales.
2. Tail very short and stumpy.
3. Teeth on one jaw only.
4. Some vestiges of pelvic bones present inside the body.
5. Palato-maxillary arch not complete.
6. Prefrontal bone forming a suture with nasal.

(*a*) 1. Teeth only in upper jaw
2. 16–36 scales round the body .. .. .. **Typhlopidae**

(*b*) 1. Teeth only in lower jaw
2. 14 scales round the body .. **Leptotyphlopidæ**

II. SNAKE LIKE BODY

Eyes exposed.

1. There is a distinction between dorsal and ventral scales.
2. Tail tapering and long.
3. Teeth on both the jaws.
4. Some vestiges of hind limbs seen outside the body.
5. Plato-maxillary arch complete.
6. Prefrontal in contact with nasal.

(*a*) (*i*) Vestiges of hind limbs present
1. Ventral scales narrower than the adjascent scales but not distinct.
2. Body covered round by 19–23 scales .. .. **Anilidae**

(*ii*) Ventral scales broader than adjascent scales.
1. More than 40 scales round the body.
2. Vestiges of hind limbs terminating in a claw like spur, seen on each side of the vent .. **Boidae**

(*b*) No vestiges of hind limbs.
1. Bones of the skull united.
2. Prefrontal in contact with nasal.
3. Ventral scales well developed.
4. Premaxillary teeth present.

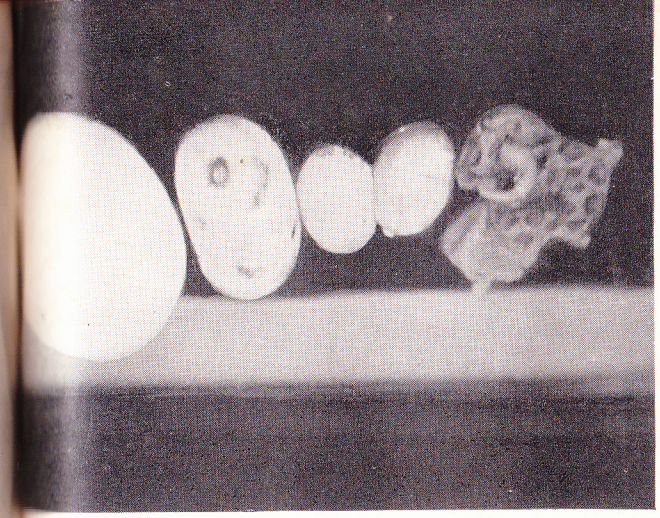
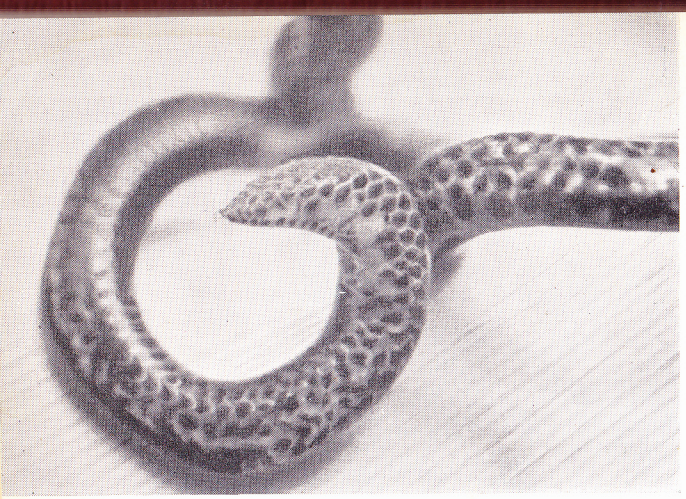


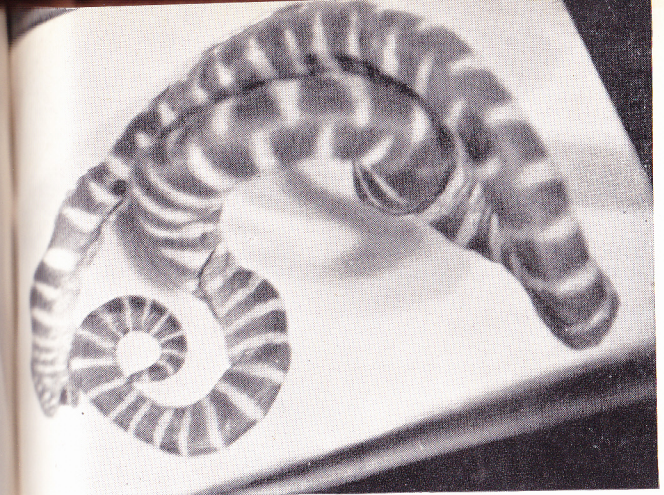
Fig. 32. Photograph showing the comparative size and shape of fowl egg, rat snake egg, Cobra egg, Krait egg and R. V. embryos.

Fig. 40. *Typhlops braminus.*
The snake on a croton tree showing the size and imbricate scales.

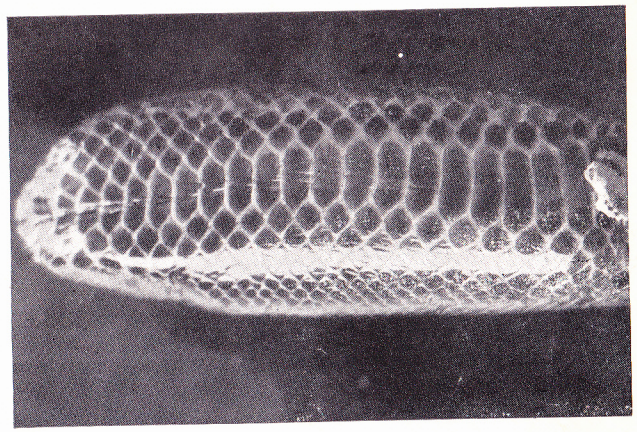


(*a*)

(*b*)



(*c*)



(*d*)

Fig. 35. Tails of different snakes.

(*a*) Rough end tail of Uropeltidae.

(*b*) Flat tail of sea snake showing ventral scales as only a ridge.

(*Fig. 35.*)

(*c*) Oar like tail of a sea snake.

(*d*) Blunt tail of a sand boa.

(*a*)

Fig. 39. Coral snake (*Callophis melanurus*).

(*a*) Showing head scales and dark bands.

(*b*) General appearance.

(*b*)

A. No poison fangs in front of jaw.

(*a*) Ventral scales well developed but not extending across the belly.

1. Ventral scales scarcely broader than adjacent scales.
2. Tail extremely short ending obtusely and covered with modified scales .. .. **Uropeltidae**

OR

Ventral scales equal or broader than adjacent scales.

1. Tail longer.
2. Premaxillary teeth present.
3. An azygous occipital shield in contact with frontal .. **Xenopeltidae**

(*b*) Ventral scales extending across the belly.

(*i*) 1. Scales of the body in 15 rows.
2. Maxillary bone edentitous except for a few minute teeth.
3. Pupil vertical.
4. Hypophyses of anterior vertebrae piercing oesophagus .. .. .. **Dasypeltidae**

(*ii*) 1. Scales in more than 15 rows.
2. Teeth in both the jaws.
3. Prefrontal in contact with nasal.
4. Pupil round or vertical.
5. Tail cylindrical and pointed .. .. .. **Colubridae**

B. Poison fangs in front of jaw.

(*a*) (*i*) The anterior maxillary teeth tubular.

1. Tail compressed vertically (paddle shaped).
2. Pupil round.
3. Maxillary bone horizontal with teeth behind the fangs — **Hydrophiidae**

(*ii*) 1. Tail cylindrical.
2. Ventral scales nearly as broad as belly.
3. Pupil round.
4. Fangs tubular .. .. — **Elapidae**

(*iii*) 1. Pupil vertical. Tail cylindrical.
2. Maxillary bone very short, vertically erectile bearing fangs only.
3. No teeth on maxillary bone except poison fangs.
4. Fangs canaliculate .. — **Viperidae**

TABLE III

DISTRIBUTION OF DIFFERENT SPECIES OF SNAKES RECORDED IN INDIA[1]

Order:	Squamata.	
Sub-order:	Serpents.	
Family:	**Typhlopidae**	
	Genus: Typhlops:	
	Species: porrectus	Himalayas, Punjab, Bihar, U.P., Orissa, Bengal, Bombay, Bangalore, Kerala.
	braminus	All over India.
	psammeces	Madras.
	thrustoni	Nilgiris, Kerala.
	jerdoni	Eastern Himalayas, Assam.
	tenuicollis	Assam.
	diardi	Bengal and Assam.
	oatesi	Range not clearly known as single specimen recovered.
	bothriorhynchus	Assam.
	tindalli	Kerala.
	beddomei	Kerala, Annamalai Hills.
	oligolepis	Sikkim, Darjeeling.
	andamanensis	Andaman Islands.
	acutus	South of Ganges basin and South of Rajputana, West to Baroda and East to Calcutta.
Family:	**Leptotyphlopidae**	
	Genus: Leptotyphlops:	
	Species: macrorhynchus	(not in India.)
	blanfordi	(not in India.)
Family:	**Uropeltidae**	
	Genus: Melanophidium:	
	Species: punctatum	Kerala, Annamalai Hills, Telewady at Goa border.
	bilineatum	Tirrhioot Peaks, West of Manantoddy (Coorg).
	wynaudense	Manantoddy dist. (Coorg), 3,000–5,000 ft. height.
	Genus: Platyplectrurus:	
	Species: trilineatus	Annamalai Hills and Kerala.
	madurensis	Palni and Travancore Hills, 4,000–6,000 ft. height.
	Genus: Teretrurus:	
	Species: sanguineus	Wynaad, Annamalai Hills, Kerala, 4,000–7,000 ft. height.

[1] Smith (1943). India was partitioned in 1947 and the States were reorganised in 1956. Some of the places are now in Pakistan. Also there have been some changes in the names of places, such as, Bombay (*now* Maharashtra), C.P. (*now* Madhya Pradesh), Rajputana (*now* Rajasthan) and Travancore (*now* Kerala) referred to in the above table.

	rhodogaster	Palni Hills (South India).
Genus :	*Plectrurus :*	
Species :	*perroteti*	Nilgiris, Annamalai Hills, 4,500–6,000 ft. height.
	guentheri	Sispara ghats on the western side of Nilgiri Hills.
	aureus	Chambara Hills, Kerala.
	canaricus	Mysore, 6,000 feet.
Genus :	*Uropeltis :*	
Species :	*nitidus*	Annamalai Hills.
	ocellatus	Western Ghats, Nilgiris, Annamalai Hills.
	dindigalensis	Madura.
	beddomei	Annamalai Hills.
	macrorhynchus	Annamalai Hills.
	wood-masoni	Travancore, Tinnevelly, Nilgiris, Palni Hills.
	macrolepis	Mahabaleshwar Hills.
	ceylanicus	Travancore Hills.
	arcticeps	Palghat, Tinnevelly Hills, Western Ghats, Travancore Hills.
	rubromaculatus	Nilgiri Hills.
	rubrolineatus	Western Ghats, Travancore Hills.
	phipsoni	Western Ghats, Annamalai Hills.
	myhendrae	Western Ghats.
	broughami	Palni Hills, Simmalai Hills, Nilgiris, Madura.
	maculatus	South India, Nilgiris, Annamalai Hills, 4,000–5,000 feet.
	petersi	Annamalai Hills, 4,000–5,000 feet.
	liura	Madura and Tinnevelly Hills, 3,000–5,000 feet.

	pulneyensis	Palni and Travancore Hills, Madura district, 5,000–7,000 feet.
	grandis	Annamalai Hills, 4,000–4,700 feet.
	melanogaster	Hills of Central Province.
Genus :	*Rhinophis*	
Species :	*sanguineus*	Mysore, Wynaad, Nilgiris, Travancore, Tinnevelly.
	travancoricus	Trivandrum, Pirmed, Ernaculam upto 4,000 feet.
Family :	**Xenopeltidae**	
Genus :	*Xenopeltis*	
Species :	*unicolor*	Andamans.
Family :	**Boidae**	
Genus :	*Python*	
Species :	*molurus*	All over India.
Genus :	*Eryx*	
Species :	*conicus*	All over India and Nainital area of Himalayas.
	johnii	Rajasthan, Uttar Pradesh, Punjab, Western India.
Family :	**Colubridae**	
Sub Family :	Dipsadinae	
Genus :	*Pareas :*	
Species :	*macularius :*	Gopaldhara and Darjeeling districts of Bengal.
	monticola :	Eastern Himalayas, Sikkim, Darjeeling district, Assam.
Sub Family :	Xenoderminae	
Genus :	*Stoliczkaia :*	
Species :	*khasiensis :*	Khasi hills of Assam.
Sub Family :	Acrochordinae:	
Genus :	*Acrochordus*	
Species :	*granulatus :*	Coasts of India as far as Bombay.

Sub Family:	Colubrinae	
Genus:	*Elaphe*	
Species:	*prasina:* (Green tree racer)	From Darjeeling to Assam.
	frenata	Assam, Khasi Hills.
	oxycephala	Andaman and Nicobar Islands.
	radiata	Orissa and Eastern Himalayas.
	flavolineata	Andaman Islands.
	helena	Peninsular India to Sind, Himalayas, Assam.
	taeniura	Darjeeling.
	hodgsoni	Himalayas from Laddakh and Kashmir to Sikkim and Assam.
	cantoris	Eastern Himalayas, Assam.
Genus:	*Ptyas:* (Rat snake)	
Species:	*mucosus* (Dhaman)	All over India.
Genus:	*Zaocys:*	
Species:	*nigromarginatus:*	Nepal, Sikkim, Darjeeling and Assam Hills upto 7,000 feet.
Genus:	*Coluber*	
Species:	*ventromaculatus:*	North Western India (Almorah in U.P. and Khandesh in Maharashtra).
	rhodorhachis:	North West India.
	fasciolatus:	Peninsular India extending North West upto Baroda through Gwalior to the Himalayas South of Nepal and Western Bengal.

Species:	*gracilis*	Neighbourhood of Bombay, Madhya Pradesh (Asirgarh).
	diadema	Gilgit, U.P.
	arenarius	Rajasthan.
Genus:	*Opheodrys:*	
Species:	*doriae*	Assam.
Genus:	*Liopeltis*	
Species:	*frenatus*	Assam Hills.
	stoliczkae	Sikkim, Darjeeling and Assam (Hills).
	calamaria	Western Ghats upto Matheran.
	rappi	Simla, Darjeeling and Nepal.
Genus:	*Coronella*	
Species:	*brachyura*	Northern India, Poona (A rare snake).
Genus:	*Oligodon*	
Species:	*cyclurus:*	North Eastern India.
	juglandifer	Eastern Himalayas (Darjeeling).
	albocinctus	Assam, Sikkim, Bengal.
	theobaldi	Assam (Tura and Garo Hills).
	venustus	Western Ghats, South of Goa, Nilgiris, Palni and Travancore.
	travancoricus	Western Ghats, Travancore and Tinnevelly Hills.
	wood-masoni	Andaman & Nicobar Islands.
	taeniolatus	Whole of Peninsular India from Sind to Bengal.
	arnensis:	Peninsular India to Sind.
	affinis:	Western Ghats, South of Goa (Wynaad to Travancore).

	brevicauda:	Western Ghats south of Goadan gap.
	erythrogaster	Eastern Himalayas, Nepal, Darjeeling.
	dorsalis	Assam, Bengal.
Genus:	*Ahaetulla:*	
Species:	*ahaetulla*	Bengal and Eastern Himalayas.
	cyanochloris	Bengal, Assam.
	grandoculis	Western Ghats, Travancore, Tinnevelly, Nilgiri Hills and Wynaad.
	gorei	Darjeeling, Assam.
	biffrenalis	Southern India, Trivandrum and Travancore.
	caudolineolata	Southern India, Ramnad and Travancore.
	tristis	Peninsular India as far as Sind border in the North-West and Darjeeling in the North-East.
Genus:	*Chrysopelea:*	
Species:	*ornata*	Darjeeling, Bihar & Orissa.
	paradisi	Andaman Islands.
Genus:	*Lycodon:*	
Species:	*travancoricus*	Western Ghats to Matheran. Also at Arcot, Vizagapattam in Eastern Ghats, M.P., Nilgiris.
	jara	Madras, Bengal and Assam.
	flavomaculatus	Nasik, Poona, Deolali and other parts of Maharashtra.
	mackinnoni	Mussoorie, Almorah, Naini Tal.
	aulicus	All over India (common wolf snake).

(*a*)

(*b*)

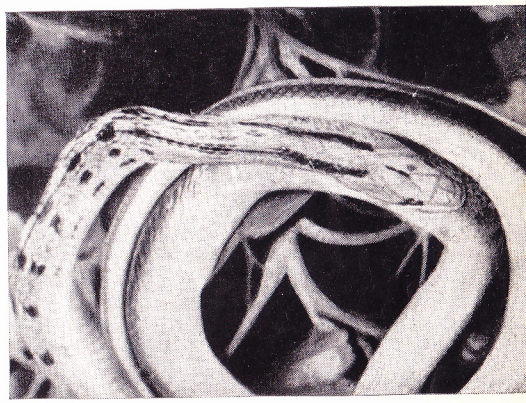


Fig. 41. Oligodon (*Oligodon venustus*). (*a*) & (*b*)

Fig. 48. King Cobra hatching out of an egg. (*Photo: New York Zoological Society — The Zoological Park*).

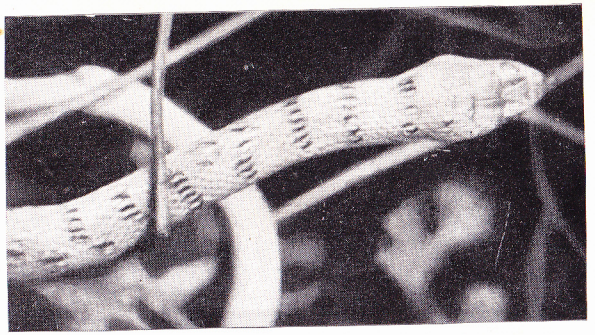
(*a*)

Fig. 42. *Oligodon arnensis.*

(*a*) On a croton shrub.

(*b*) Life size.

(*b*)



(*a*)

Fig. 43. Common Wolf Snake (*Lycodon aulicus*).

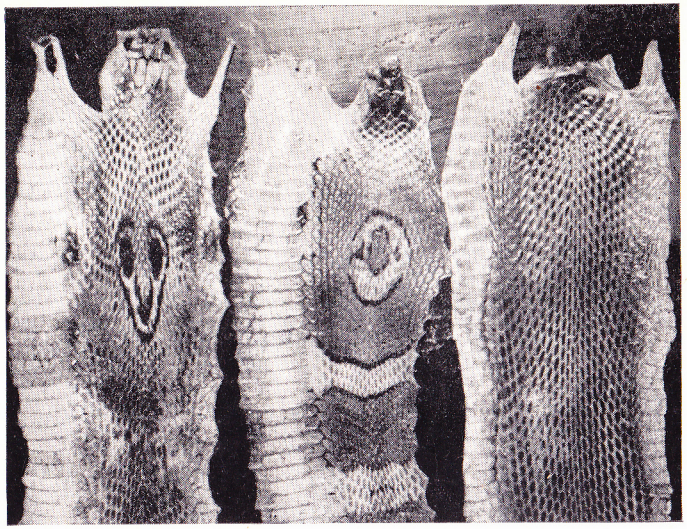
(*a*) Snake going up a bush.

(*b*) Snake caught swallowing a skink.

(*c*) Living Lycodon showing the size in handling.

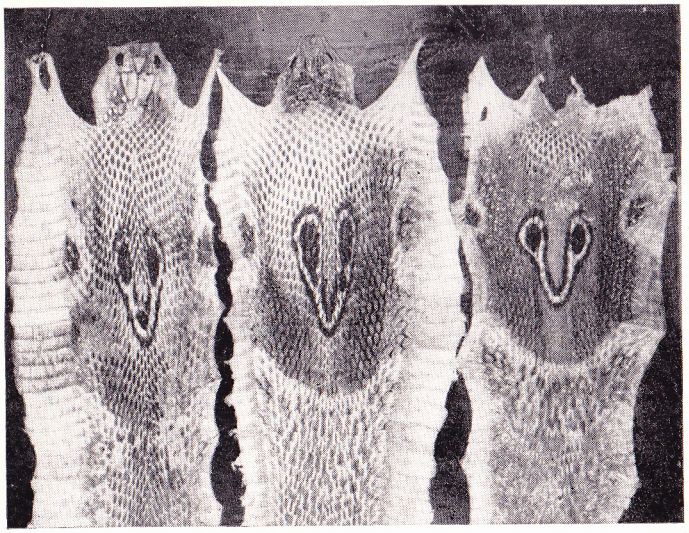
(*b*)

(*c*)



(*a*)

Fig. 44. Skins of cobras showing the different marking pattern on the head.
(*a*) Binocellate mark.
(*b*) Different kinds of binocellate marks.



(*b*)

	fasciatus	Eastern Himalayas, Assam.
Genus:	*Dinodon:*	
Species:	*septentrionalis*	Darjeeling, Assam.
	gammiei	Sikkim and Darjeeling Districts.
Genus:	*Dryocalamus:*	
Species:	*nympha*	Western, Southern India and Orissa.
	gracilis	Peninsular India (Annamalai Hills, Cudapah Hills), Orissa.
Genus:	*Sibynophis:*	
Species:	*collaris*	Simla and Assam.
	subpunctatus	Matheran, Nasik, Bengal, M.P.
	saggitarius	Madhya Pradesh and Uttar Pradesh, Western Bengal and Western Himalayas.
Genus:	*Natrix:*	
Species:	*parallela*	Sikkim, Assam.
	nicobariensis	Nicobar Islands.
	khasiensis	Khasi and Garo Hills in Assam.
	xenura	Cherrapunji in Khasi Hills and Assam.
	piscator	North West and Madhya Pradesh.
	himalayana	Eastern Himalayas as far west as Sikkim.
	stolata	All over India.
	platyceps	Himalayas from Kashmir in the west to Assam in the east, 5,000–6,000 feet.
	beddomei	Western Ghats south of Mahabaleshwar, Nilgiris, 3,000–7,000 ft.
	monticola	Western Ghats from Talewadi to Travancore.

Genus:	*Pseudoxenodon:*	
Species:	*macrops*	Nepal, Assam.
Genus:	*Macropisthodon:*	
Species:	*plumbicolor*	All over India except Ganges Valley and the extreme North West.
Genus:	*Xenochrophis:*	
Species:	*cerasogaster*	U.P., Bengal, Assam.
Genus:	*Atretium:*	
Species:	*schistosum*	Annamalai Hills, Wynaad, Mysore, U.P., Orissa.
Genus:	*Trachischium:*	
Species:	*monticola*	Assam Hills.
	fuscum	U.P. and Assam (Hilly regions 5,000–7,000 ft.).
	guentheri	Sikkim, Bengal between 3,000–7,000 ft.
	tenuiceps	Nepal, Sikkim, Bengal.
	laeve	Western Himalayas.
Genus:	*Rhabodops:*	
Species:	*olivaceus*	Western Ghats (Wynaad), Assam.
	bicolor	
Genus:	*Blythia:*	
Species:	*reticulata*	Hills North and South of Brahmaputra to Manipur in Assam.
Genus:	*Xylophis*	
Species:	*perroteti*	Western Ghats (Wynaad to Tinnevelly).
	stenorhynchus	Western Ghats (Annamalai Hills to Tinnevelly).
Genus:	*Boiga* (Cat snake)	
Species:	*multimaculata*	Assam (Sylhet).
	ochracea	Eastern Himalayas, Assam and Nicobar Islands.

	trigonata	Whole of peninsular India, Western and Eastern Himalayas, Sikkim, Bengal.
	gokool	Eastern Himalayas, Darjeeling, Assam.
	ceylonensis	Western Ghats.
	quincunciata	Assam.
	cyanea	Darjeeling, Assam.
Species:	*multifasciata*	Western Himalayas and Eastern Himalayas.
	cynodon	Bengal and Assam.
	forsteni	Peninsular India, Western Ghats, Ganges Valley, Orissa.
	dightoni	Travancore.
Genus:	*Psammophis:*	
Species:	*schokari*	Rajasthan, Punjab, Kashmir.
	condanarus	Cutch, Punjab, Central India, U.P., Bihar, Orissa, Bengal.
	longifrons	Bombay, M.P.
	leithi	Bombay, Rajasthan, U.P., Punjab, Kashmir.
Genus:	*Psammodynastes:*	
Species:	*pulverulentus*	Eastern Himalayas upto Nepal.
Genus:	*Dryophis*	
Species:	*dispar*	Western Ghats, (Nilgiris and North Canara) at 5,000 ft.
	fronticinctus	Assam and Darjeeling.
	nasutus	Peninsular India, Bengal.
	prasinus	Bengal, Sikkim and other parts of the Eastern Himalayas.
	pulverulentus	Western Ghats.

	perroteti	Western Ghats, Nilgiris.
Sub-Family:	Homalopsinae (*Fresh water snakes*)	
Genus:	*Enhydris:*	
Species:	*enhydris*	U.P., Bihar, Bengal, Assam and Orissa.
	sieboldi	Travancore, Bombay, Delhi, Agra, Bihar, Assam.
Genus:	*Cerberus:*	
Species:	*rhynchops*	Coast and tidal rivers of India from Bombay to Cochin.
Genus:	*Gerardia:*	
Species:	*prevostiana*	Coastal and tidal rivers of Bombay and Malabar Districts.
Genus:	*Fordonia:*	
Species:	*leucobalia*	Bengal.
Family:	**Dasypeltidae**	
Genus:	*Elachistodon* (Indian egg eater)	
Species:	*westermanni*	Northern Bengal and Bihar.
Family:	**Elapidae**	
Genus:	*Bungarus* (Kraits)	
Species:	*bungaroides*	Eastern Himalayas, Assam.
	fasciatus (Banded Krait)	North East India, U.P., M.P., Bihar and Orissa.
	caeruleus (Common Indian Krait)	All over India except Kashmir at North, Bengal, Assam at East and below Hyderabad in the South.

	niger (Black Krait)	Darjeeling, Assam.
	lividus	Bengal and Assam.
	walli	U.P., Bengal, Bihar and Orissa.
Genus:	*Callophis:*	
Species:	*melanurus*	Bombay, Malabar, Dharwar, Coimbatore, Annamalais, Bengal and C.P.
	nigrescens	Nilgiris, Annamalais, Travancore, Panchgani-Mahabaleshwar.
	beddomei	Shevaroy Hills of Mysore.
	macclellandi (Coral snake)	Assam and Darjeeling.
	bibroni	Western Ghats as south as Coorg.
Genus:	*Naja* (Cobra):	
Species:	*naja*	Peninsular India.
	oxiana	Punjab and Kashmir.
	kaouthia	Bengal and Eastern Himalayas.
	hannah (King Cobra)	Peninsular India to Himalayas.
Family:	**Hydrophiidae** (Sea snakes)	
Genus:	*Laticauda:*	
Species:	*laticaudata*	Bay of Bengal.
	colubrina	Andaman and Nicobar Islands water.
Genus:	*Kerilia:*	
Species:	*jerdoni*	East coast of Indian Peninsula.

Genus:	*Praescutata:*	
Species:	*viperina* (completely banded from India)	Karwar waters (Only one specimen from India).
Genus:	*Enhydrina:*	
Species:	*schistosa*	(From the Persian Gulf to the North coast of Australia).
Genus:	*Hydrophis:*	
Species:	*nigrocinctus*	Bay of Bengal.
	spiralis	(From the Persian Gulf to Malayan Peninsula).
	cyanocinctus	West coast of Indian Peninsula.
	obscurus	East coast of India.
	stricticollis	East coast of India, North of Orissa.
	ornatus ornatus	From the Persian Gulf of China.
	lapemoides	Western and Eastern coasts of India.
	mamillaris	Coasts of India, Gulf of Cambay, Bombay and Vizagapattnam.
	caerulescens	Bombay and Karwar on the Western coast and from Madras to the mouth of Ganges on the Eastern coast.
	fasciatus	Coasts of India on Eastern side, rare on the Western coast of the India Peninsular Region.
Genus:	*Lapemis:*	
Species:	*curtus*	West coast of Peninsular India.

Genus:	*Microcephalophis:*	
Species:	*gracilis*	From the Persian Gulf to coast of Australia.
	cantoris	West coast of India to Cannanore and on east from Orissa, Chittagong.
Genus:	*Pelamis* (Most widely distributed of the sea snakes):	
Species:	*platurus*	Common in Indo-Australian waters and hundreds of miles from the coast.

Family: **Viperidae**
Vipers

Sub-Family:	Viperinae	
Genus:	*Vipera:*	
Species:	*russelli* (Russell's viper)	All over India from Ceylon to Himalayas in plains as well as upto the height of 7,000 ft.
	labitina	Kashmir.
Genus:	*Echis:*	
Species:	*carinatus* (Saw-scaled viper)	All over India, South of Ganges except Bengal, Kashmir.
Genus:	*Pseudocerastes* (Horned vipers):	
Species:	*persicus*	(Sometimes in N.W.F.P. only).
Sub-Family:	Crotalinae	
Genus:	*Ancistrodon* (Pit vipers):	
Species:	*himalayanus*	Western Himalayas from Chitral to Sikkim, Khasi Hills in Assam.

	hypnale (Hump nosed viper)	Western Ghats as North as latitude 16°, *i.e.*, upto Goa.
Genus:	*Trimeresurus* (Pit vipers) :	
Species:	*macrolepis*	Southern India Hills, Nilgiris, Annamalai Hills, Travancore.
	mucrosquamatus	Naga Hills.
	monticola	Eastern Himalayas as far west as Nepal.
	jerdoni	Khasi Hills, Assam.
	malabaricus	Hills of Western and Southern India varying from 2,000–7,000 ft. (Mahabaleshwar, Goa, N. Canara, Coorg, Nilgiris, Annamalai Hills, Palni and Travancore Hills).
	strigatus	Southern India between 3,000–6,000 ft. (Nilgiris, Annamalai Hills and Palni Hills).
	gramineus (Bamboo pit viper)	Peninsular India, South of Hyderabad, common at coastal rocks, N. Canara district, Lonavala.
	stejnegeri	Darjeeling, Assam, Shillong and other Eastern Himalayan Regions.
	popeorum cantori	Eastern Himalayas, Assam Nicobar Islands.

purpureomaculatus andersoni	Exclusively from Andaman Islands.
erythrurus	Bengal, Assam and other parts of the Eastern Himalayas.
albolabris	Punjab, M.P., Nepal.
labialis	Only from Nicobar.

NON-POISONOUS SNAKES

FAMILY: TYPHLOPIDAE

TYPHLOPS BRAMINUS

THE COMMON BLIND SNAKE

Hindi : *Andha samp*
Gujarati : *Bandhani chakan*
Marathi : *Danav, Kadu.*

Distribution: All over India.
Length: 170–180 mm.

This blind degenerate snake is brown with a shining chocolate hue above, lighter below and the head and tail region slightly whitish. It is found in rotting vegetation and is sometimes recovered from uncleaned bathrooms in rural homes. They represent old snakes and are found in semitropical and tropical regions.

These snakes look like an earthworm, but they have a much darker colour and have imbricate scales all over the body. There is no distinction between dorsal and ventral scales. The earthworm has circular rings round the body. There are 20 scales round the body. There are 300–320 rows of transverse scales (*Figure 40*).

The head is not distinct from the body. The tail end is blunt with a small point. In soft earth they burrow rapidly. Their movements on ground are slow, while in soft earth many of them stick a spine or point of their tail in ground and progress forward with a jerk. Typhlops digs out tree bases quickly to burrow. They open and shut the mouth, intimidating, as if to bite.

These snakes feed on worms, soft bodied insects and their larvae. They have a few teeth in the upper jaw only. In the simple head region bones are not properly ossified. Mahendra[1] and Mookerjee and Das[2] mention that the parietal bone in these snakes is paired. These snakes have a large rostral, nasal, ocular and preocular shields on the head. Nasal shields are completely divided into an anterior lower and a posterior upper portion, the cleft passing through the nostril. The eyes are tiny, more or less covered by scales. Sebaceous glands are present on the body.

These snakes are usually oviparous.

FAMILY: UROPELTIDAE

UROPELTIS OCELLATUS

Distribution: Western Ghats upto Nilgiris and in Maharashtra.
Length: 540 mm.
Thickness: 25 mm.

Different species of this snake are available in other parts of India. They differ in colouration and pattern, but all have got roughness of tail as the common characteristic along with their habitat at higher altitudes. The details of distribution are given under Table III. The scalation is primitive and the differentiation between dorsal and ventral scales is seen along with some head scales. The ventrals nevertheless are small and do not cover the entire area.

Both the ends of this snake are blunt. The mouth end is slightly tapering. The tail end is blunt but near the tip the scales are rough and the tail becomes as if flatly blunt. Because of the roughness of the scales in the tail, the snakes are called rough-tailed (*Figure 35-a*).

Eyes are present, they range in size from one-fifth to one-third of the length of the ocular shield.

This snake is thicker than the human thumb and is normally met with at higher altitudes. It feeds on insects, larvae and is normally seen moving through soil and decaying vegetation. It makes an

[1] Mahendra (1936).
[2] Mookerjee and Das (1932).

effort to burrow in soil and sometimes lashes the rough pointed tail. It is a non-poisonous, harmless snake which often shuns light, but the colouration it shows in movement often betrays the animal. The snake is viviparous, *i.e.*, laying young ones directly.

FAMILY: BOIDAE

PYTHON MOLURUS

INDIAN PYTHON

Hindi, Gujarati, Marathi } *Ajgar*
Tamil: *Priya Pambu*

Distribution: Throughout India particularly in rocky wet regions with bushes.
Length: 7,000 mm. as a maximum. The maximum girth at the thickest is about 900 mm.

The head scales are prominent. 11 to 13 supralabials. The first two are full of pits, the sixth and seventh touching the eye or partly separated by suboculars. The infralabials are from 16 to 18; anterior ones are long and narrow and posterior ones partly pitted. Parietal, loreal and temporal regions are covered with irregular scales (*Figure I col.*).

The scales are in 60 to 75 smooth rows, the ventrals are distinctly smaller ending in a short tail. Just near the anal, are two claw-like spurs which are rudiments of appendages. This is the only snake which exhibits these rudiments, that can often inflict serious injuries. The size of these appendages is about 45 mm. long and about 20 mm. at the thickest.

The rostral scale on the head bears a deep pit on either side. The function of the pit is probably thermo-receptive.

It is brown above (*Figure II col.*) with Rhomboid dark grey edged spots on the body. There is a lancet shaped brown mark on the head and tapering pink brown stripes at the sides of the head going even anterior to the eyes. The ventral side is greyish with yellow

and brown spots more prominently seen in the tail region. After a fresh shedding of the skin, the snake looks iridescent and is heard to hiss quite loudly.

This is about the biggest and the thickest snake of India. It weighs to a maximum of 250 lbs. Many a tale has been woven about its propensity to catch a prey by suction or its capacity to strangulate victims. In ancient literature depicted in Mahabharata King Nala leaves his wife Damayanti in a jungle and she was supposed to have been entwined by a huge python.

This snake is sometimes eaten, and it is reported to have been used to feed the "Chindwin" expedition that went through Burmese jungles during the second world war.

This snake can climb and lives in wet rocky regions. It is a good swimmer also. When on trees it lies motionless waiting for a victim to come, which it kills by strangulation. It feeds on birds, reptiles and mammals. Though it is a lethargic snake; on sight of the prey it becomes very active, hurling its head at the body of the prey and strangulating the victim with the coils of its muscular body.

The other variety *P. reticulatus* first catches the head of the victim at the mouth end while *P. molurus* catches it anywhere in the body. After death of the victim, the prey is gradually shoved inside the mouth and the snake lies quite for some time in rest. It also twines round tree trunks possibly to crush the bones of the victims. It has been observed to have crushed even a boar, while goats are often seen to have been killed. During winter months it hibernates. Immediately after winter months it lays eggs to the tune of 107. It has a maternal instinct inasmuch as the females remain coiled round the eggs that they hatch. The eggs are said to hatch in about 60 days. The growth observed in the laboratory here has shown that during these years, the snake grew at the rate of six to eight inches per year, but one did not know how old it was when it came to the laboratory.

There is another python, *Python reticulatus*, which is thinner than *P. molurus*, but much longer. The author had seen one in 1930 in the deep forest at Ratanpur in Madhya Pradesh. It is the largest snake and the author by the movement of the snake thinks it to be about 30 feet long. There are no other authentic

records about this snake in India apart from the above. There is a difference in colouration and some scalation between these two pythons.

ERYX CONICUS

SAND BOA

Hindi: *Dumuha*
Marathi: *Durkya Ghonas*
Kannada: *Netragodchi hawu*

Distribution: All over India.

Length: 480 mm. in male and twice that in females.

It is a pinkish grey snake with deep brown irregular patches all over the body. The patches are edged by black borders. The ventral side is faint yellow with brown spots on the outer sides.

The scalation on the head is very primitive. The head is not distinguishable from the neck. Eyes are very small with a vertical pupil. Nostril is like a slit. Only three scales on the head are enlarged and the rest of the head is covered by small raised scales. Ten to fifteen scales are present round the eye. Body scales are 40–55 in rows often keeled, particularly on the tail. The ventral scales do not run across the belly (*Figure 37–2*).

This snake remains hidden in sandy soils. It often prefers to burrow in soft areas lying partly hidden where the body colour is in keeping with the surroundings. It feeds on frogs, mice, lizards, etc.

This snake could always be distinguished by its blunt tail which looks like the head end, the eyes being small and the fact that it sometimes crawls back; as such it is often mistaken to be a two-headed snake, that is a snake having heads at two ends. This is not true (*Figure III col.*).

In the laboratory we have seen it to be pretty vicious, striking on instant touch and biting forcibly. It is often mistaken to be the young one of a Python; but it can be distinguished from the latter by the shape of its tail, the small scales on the head, the colouration and the absence of the primitive appendages at the anal end (*Figure 12-a*).

This snake is oviparous, laying eggs during summer months.

There is another sand boa very common in India, which is more docile than the above. This is chocolate in colour with a similar pattern of scales and shape of tail. It lies buried in soil and is called *Eryx Johnii* or John's sand boa. This snake is much longer than *Eryx conicus* and is also found all over India. It is called *Mandol* in Marathi.

FAMILY: COLUBRIDAE

Sub-family: Acrochordinae

ACROCHORDUS GRANULATUS

WART SNAKE

Distribution: West coast of India, Nicobar Islands.
Length: 1,000 mm.

Dark grey with faint white cross bars or spots which are indistinct in the adult. Head chocolate with yellowish spots and full of small scales. The nasal opening is on the upper surface of the head. Dark bands round the body. In fact the snake appears greyish with dark bars across the body.

About 100 scales round the body, partly covering each other and each scale having a central tubercle. On the underside there is a fold of skin at the centre. This fold contains small spinous scales.

Some authorities think that this is quite common in the coastal areas of India, chiefly in estuaries and may be collected by fishermen in nets. It does not move much on land and feeds on fishes and frogs. It is viviparous, producing 6–8 young ones at a time.

ELAPHE HELENA

TRINKET SNAKE

Distribution: Hilly regions, Assam, NEFA, Almora, Western Ghats.
Length: 1,350 mm. in female and 900 mm. in male.

Dark brown above with deeper brown or black cross bars containing white ocelli. These bars become incomplete posteriorly.

There is a dark stripe below the eye and one behind it. Underside is yellowish. Snout small. Prefrontal as long as the internasals. Loreal a little longer than high. Fifth and sixth supralabial touching the eye. Scales on the body distinctly keeled on the posterior part and the tail.

This is a vicious snake. When disturbed it assumes a provocative attitude. It feeds on lizards, mammals, frogs and snakes. It is an oviparous snake.

Elephe hodsoni (copper head) is found in Kashmir, Laddakh and Sikkim regions. It is locally called "Kulpar". It ranges from 1,500 mm. in male and 1,250 mm. in female in length. The colour is olive green with a number of scales edged with black. The ventral side is yellowish and the outer margins have black spots. It differs from *E. helena* in having the anterior maxillary teeth as largest, snout more than two times as long as eye, fourth and fifth supralabial touching the eye. Scales 17 rows and are smooth or faintly keeled.

PTYAS MUCOSUS

RAT SNAKE

Hindi, Gujarati, Marathi } *Dhaman*
Bengali: *Dharas*
Kannada: *Kiyai hawu*
Tamil: *Surepembu*

Distribution: All over India in plains and also at some altitudes.
Length: 2,250 mm. in males and 1,800 mm. in females.

Eyes large and with a round pupil. Iris golden. Head distinct from neck. Loreal region concave with two or three shields, a presubocular, nostrils large, between two nasals. Two post-oculars and fourth and fifth supralabials touching the eye. Supraocular forms a ridge on eye.

Scales on the body 16 to 17 rows, with some rows slightly keeled.

This widely distributed snake is (*Figure IV col.*) dirty yellow coloured with tips of scales black. The anterior and latero-ventral

scales with very prominent black borders and cross-bars on the posterior part including the tail. Subcaudals paired and edged with black. Young are olivacious yellow, and the markings are very distinct.

It is a timid snake that can climb a tree and lives mainly in the plains feeding on mammals, frogs, toads, lizards and even snakes. In fact some grain godowns that had a rat snake were found to be comparatively free from rats. When cornered, it inflates the lower part of the head and can bite viciously. It throws coils of its body on the victim. In fact the tail is long and prehensile. It has been seen to use the tail to tie a knot and exert a pull (*Figure 23*) on the victim. This snake emits a foul odour on touch and also secretes a black secretion from anal glands. It is commonly believed that this snake ties such a knot on the legs of cattle and sucks the udders. This may not be true. We have further observed that this snake when squeezed gives a gutteral noise like that of a kite. In spite of its ferrocious look, it can be domesticated and handled without being bitten. There is no truth in the belief that it mates with a Cobra.

It can climb a tree with ease and is known to have taken birds and fowl.

It is oviparous. The eggs are blunt at both ends (*Figure 32*). The young emerge during the rainy season.

Lastly, there are reports to show that this snake is eaten in some rural areas. It is a non-poisonous snake.

COLUBER VENTROMACULATUS

RACERS

Marathi: *Nagin*

Distribution: Hilly regions of U. P. and Maharashtra.

Length: 1,090 mm. in male, 1,000 mm. in female.

Grey dorsally, with a dorsal series of black cross-bars or spots restricted to scale borders. A series of finer spots at the lateral sides, alternating with cross-bars. Ventrally yellowish. Neck with a black stripe and a black bar below the eye. Pupil round.

Head distinct from neck. Nine supralabials, ninth, fifth and sixth supralabials touching the eye. Sixth supralabial highest and in contact with lower anterior temporal. Two post-ocular, loreal squarish, subcaudals paired. Maxillary teeth 14 to 15. Ventrals with a small keel.

A vicious snake, when disturbed, erects the head and flattens the area behind the neck. This quality it shares with another snake the Banded racer *Coluber fasciolatus* which is found in the Western part of India, Gujarat to Central India, Nepal and Western Bengal. They feed on lizards, frogs and birds. They are oviparous.

COLUBER DIADEMA

DIADEMA SNAKE

Hindi: *Rajatbansi*

Distribution: Bombay (Bandra 1963), U. P., Delhi. Also at higher altitudes.

Length: 1,200 mm. in males and 1,500 mm. in females. Even greater lengths have been recorded.

Specimen collected from Bandra near Bombay was chrome yellow above and pale below. The dorsal surface was full of black marks as if ink had been indiscriminately thrown all over (*Figure V col.*). These spots are at places rhomboid or often irregular and they extend to the head region also, which looks partly black. The ventral surface was light pink with few lateral dark mottlings.

Maxillary teeth 16–18. Head distinct from neck. Two loreals, and a series of suboculars separating the labials from the eye. 3 to 4 postoculars. 10–13 supralabials. Scales more or less keeled and in 29 or 31 rows.

Another race of this snake has a variation in colouration containing round or rhomboidal dark spots and a regular pattern of markings having an inverted U-shaped mark on the parital shield.

The markings in both variations become less distinct in older snakes. This snake has also been observed to go up a tree where the typical colouration gives it a good camouflage for hiding. It can be

mistaken for a Russell's viper. But the latter has a triangular head and its shields are not defined.

This snake feeds on frogs, lizards and sometimes on rats. It is oviparous and is commonly seen during the rainy months.

LIOPELTIS CALAMARIA

Distribution: Western Ghats, Mysore plateau, U.P., Tarai regions and Eastern part of M.P. and Orissa. Mostly in hilly regions.

Length: 335 mm. in males, and 390 mm. in females.

It is a small brown snake showing a greenish tinge and the scale borders indicating a black line that runs longitudinally along the vertebral column. Between these lines the colouration is deeper brown. The lower side is yellowish and the head bears a series of black spots resembling a stripe extending upto temporals.

The head is distinct from the neck. Maxillary teeth 24–26. The undivided nasal is united with the loreal. Supralabials 7, 3rd and 4th touching the eye. The scales are in 15 rows.

This snake has been recorded from Matheran near Bombay. It is not a very common snake. It feeds on lizards and small birds and is common only in the hilly regions. It is oviparous.

CORONELLA BRACHYURA

Distribution: North India, Poona area and Vidarbha region of Maharashtra.

Length: 515 mm. in male and 450 mm. in females.

This is not a very common snake. It is olive brown above with variegated colours or is light brown particularly on the anterior part of the body. Ventrally white.

Large nostrils. Two post-oculars. Eight supralabials, 4th and 5th touching the eye. Scales 23 in 19 rows, ventrals large and rounded.

This is a small snake, about 100 mm. in diameter and has been observed in daytime. It probably feeds on tiny frogs and young lizards and is commonly seen during the rainy season. It is oviparous.

OLIGODON VENUSTUS

WOLF SNAKE

Hindi: *Kawdi samp*
Gujarati: *Sankh-bangani*
Marathi: *Gargar*

Distribution: Snakes belonging to this genus are common all over India. This species is in Western Ghats up to Travancore.

Length: 450 mm. in male and smaller in female.

Grey with a brown tinge and paired blackish spots having a whitish border. These often look like cross-bars of a krait. Laterally yellowish spots. Ventrals white. Head with crenate markings, and caudals paired (*Figure 41-a & b*).

Maxillary teeth 6-16, the posterior very strongly enlarged. Palatine teeth well developed or vestigial. Eyes moderate with a round pupil. Hypophyses absent on posterior dorsal vertebrae. Nostril in an elongated nasal. Two post-oculars. No loreal. 6 supralabials, 3rd and 4th touching the eye. Posterior nasal elongate, sometimes meeting the preoculars.

They feed on small rodents, lizards and birds and even insects. This snake is found in gardens and round about houses preferably coming out in the evenings. In the semi-darkness of the night, it is often mistaken for a krait.

It is a non-poisonous harmless snake and is oviparous.

Oligodon arnensis (*Figure 42-a & b*) is also extensively found in this region. It is brown with distinct cross markings and narrow dark brown cross-bars ranging from 31–41, depending upon the age of the snake. These markings are indistinct on the tail and run as double limbed dark stripes on a longitudinal black spot, extending from behind the eyes to the neck region. More than *O. venustus*, this snake looks akin in colouration to a krait.

AHAETULLA GRANDOCULLIS

BRONZE-BACK SNAKE

Distribution: Western Ghats upto Travancore.

Length: 1,280 m.m. in females and smaller in males.

These are greenish brown snakes with black blotches on the dorsal side. The tail has three black lines, one below and two laterally. No longitudinal stripes on the body or head except white rings round the eyes.

Maxillary teeth 31–33. Nine supralabials, 4th touching the eye and 5th and 6th below the eye. Vertebral scales slightly enlarged. Head distinct from neck. Eye with a round pupil. Loreal region concave. Hypophyses absent on the posterior dorsal vertebrae which are represented by a low keel.

These snakes live on trees and shrubs, feeding on bird eggs. On land they go in for frogs, toads and even lizards. They are very quick in their movements across tree branches. They are timid and could be easily handled.

Ahaetulla tristis is another common bronze-back snake very commonly met with in India, particularly at higher altitudes. These are bronze brown with buff flank stripes edged with black spots. Upper lip is yellow. Maxillary teeth are only 17–22, 5th and 6th supralabial touching the eye.

They are oviparous and the gestation period is supposed to be very small.

CHRYSOPELEA ORNATA

GOLDEN TREE SNAKE (FLYING SNAKE)

Bengali : *Kala nagini*

Distribution: Central India, Bihar, Orissa extending to Bengal, Western Ghats.

Length: 1,100 mm. in female and 1,040 mm. in male.

Pale green dorsally with blackish cross-bars formed by black edged scales at regular intervals. Some specimens have orange spots on the vertebrals. Ventrals are greenish. Laterals are slightly keeled and with a black spot. Head is black with thin yellow or pale green cross-bars and a few spots. Subcaudals are with a black median streak or spots.

Maxillary teeth are 20–22, 3rd and 4th are partly grooved. Loreals are elongate, with two postoculars. Nine supralabials,

4th just touching and 5th and 6th below the eye. Snout is depressed. Internasals shorter than prefrontals, frontal bell shaped, scales on the body are smooth, and caudals are paired.

This snake feeds on lizards, small mammals, birds, snakes and even insects. It may be seen near houses. The peculiarity about this snake is its capacity to move very fast. It can spring and move as if it is flying. This has been given the misnomer "flying snake". It can suspend itself from tree branches and attack a prey on the tree, kill it by coiling and feed itself while still suspending from branches. It is oviparous.

LYCODON AULICUS

COMMON WOLF SNAKE

Hindi : *Kawadiwala*
Bengali : *Chitti*
Gujarati : *Suwarpankhu*
Malayalam : *Shuguwarian*
Tamil : *Kuwarpambo*

Distribution: All over India.

Length: 760 mm. in males, 700 mm. in females.

Brown or purple dorsally, and with grey spots edged with white, which form a reticulate pattern of cross-bars expanding laterally (*Figure 43*). Upper lip white or with brown spots. Ventrals yellowish.

Maxillary bone arched with 3 to 6 anterior teeth increasing in size and looking like fangs. Loreal in contact with internasals. Nine supralabials, 3rd, 4th and 5th touching the eye; two postoculars. Subcaudals are paired. Hypophyses absent in the posterior part of the vertebral column.

These are garden snakes, more or less nocturnal in habits. They climb trees readily and on land show active movements. They are very vicious and bite ferociously. Their main food consists of lizards, Gekos and skinks (*Figure 43-b*). They also go in for frogs and small mammals as well as bird eggs.

They readily enter human habitations and are oviparous.

Like oligodon one can mistake this snake for a krait, due to the shape of the faint cross-bars. The shape and size of dorsal scales and paired caudals distinguishes this snake from the other.

DRYOCALAMUS NYMPHA

BRIDAL SNAKE

Tamil : *Katlawarian*

Distribution: South India, Western Ghats, Orissa.

Length: 460 mm. male, females are smaller.

Deep brown above with yellowish white broad cross-bars on dorsal side, particularly in the anterior region, yellowish spots posteriorly. Head yellowish posteriorly and lips white ventrally (yellowish white). Head is coloured deep brown up to eyes.

Loreal in contact with the eye or separated by a small preocular. Two postoculars, six to seven supralabials; 3rd and 4th touching the eye. Hypophyses absent on the post dorsal vertebrae.

This is a snake of the plains and may be found at low altitudes only. It feeds on lizards and frogs and is oviparous.

NATRIX PISCATOR

CHECKERED KEEL-BACK

Hindi : *Pani samp*
Bengali : *Joldhorna*
Gujarati : *Neer mandli*
Marathi : *Pandivad*
Tamil : *Tanir pambu*

Distribution: All over India.

Length: 990 mm. males, 1,200 mm. females.

Olivaceous snakes with dorsal black spots arranged in a pattern, one series on vertebrae, two at sides and two laterally. These five series give the impression of a chessboard arrangement (*Figure VI col.*). The pattern is more prominent posteriorly, and often these spots touch one another. A black stripe at the nape and two

black lines from behind the eyes run along the margin of sixth and eighth supralabials to the end of the upper jaw. Eyes round and seem surrounded by a white circle. Ventral side is white with black borders more prominent in the posterior region.

Maxillary teeth 22–28, enlarged posteriorly. One preocular, and nine supralabials, 4th and 5th touching the eye. Scales are in 19 rows, keeled, ventrals rounded and subcaudals paired. Hypophyses developed throughout the vertebral column.

This is a very common snake of the plains which goes near water to eat frogs and fishes. Probably the food consists mainly of fishes which it eats assiduously. It is often encountered in paddy fields during rains or one could meet it near shallow pond banks. In the laboratory we have observed it floating in water with just the tip of the nose sticking out. The remaining body lies coiled at the base. With the least disturbance it sinks down and one could see air bubbles rise up as it goes down. Here, we have found it lying in water for the major part of the day remaining completely submerged for more than fifteen minutes. It is said that in hot weather it may estivate, while in North India it hibernates during cold months.

A number of people are often bitten by this snake. It bites very viciously, often flinging at the victim. The snake is non-poisonous.

It is oviparous and has been seen to lay eggs in March-April in Bombay. The young ones appear in May–June of the same year.

NATRIX STOLATA

BUFF STRIPED KEEL-BACK

Bengali : *Halhalliah, Hur-hur-ra*
Hindi: *Seeta-ki-lat*
Malayalam : *Therlian*
Marathi : *Naneti*
Tamil: *Wanapapambu*
Telugu: *Vanacogli*

Distribution: All over India.

Length: 720 mm. in males and 620 mm. in females, circumference about 30 mm.

Olive green snake with reticulated black spotted irregular cross-bars dorsally, and two buff coloured longitudinal stripes running all along the body. These stripes are prominent posteriorly, wherein spots are faint whitish ventrally with some black spots at the edges. Head with black bordered shields. Mouth with a cream coloured region extending upto eyes.

Maxillary teeth 21–24, the last two enlarged. One pre-ocular. Supralabials eight, third, fourth and fifth touching the eye. Scales in 19 rows, strongly keeled. Blackish short loreal streak. Last supralabials with a black border. Scales on body 19.

This is a very common snake in India and seen in large numbers during monsoon months. It is very docile and could be handled with ease. One sees it both during the day and night. It hibernates during winter months. Egg laying takes place in soil heaps sometime in April–May and the young ones are seen during the rainy season.

It feeds chiefly on frogs and insects and is an absolutely harmless snake.

MACROPISTHODON PLUMBICOLOR

GREEN KEEL-BACK

Marathi : *Gavtya*
Tamil : *Pacha-Naga.*

Distribution: All over India at higher altitudes.
Length: 485 mm. in male and 690 mm. in females.

Grass green dorsally with lamp black chevron shaped mark on the nape and black short cross-stripes across the body. The posterior part of the eye has a streak in black, looking like a collyrium in eyes. Ventral surface whitish. Yellow thin lines run laterally. Head with a chevron shaped mark and orange colour between this and the mark on the nape.

Maxillary teeth 11 or 12. Loreal touching second supralingual and united with lower preocular. Postoculars 3, preoculars 2, supralabials 7 of which 3rd and 4th touch the eye. Scales on the body are strongly keeled except the outer rows.

Fig. VII(b). COBRA (*Naja naja*)
(Dorsal view of hood)

Fig. VII(c). COBRA (*Naja naja*)
(Ventral view of hood and both alarmed during movement)

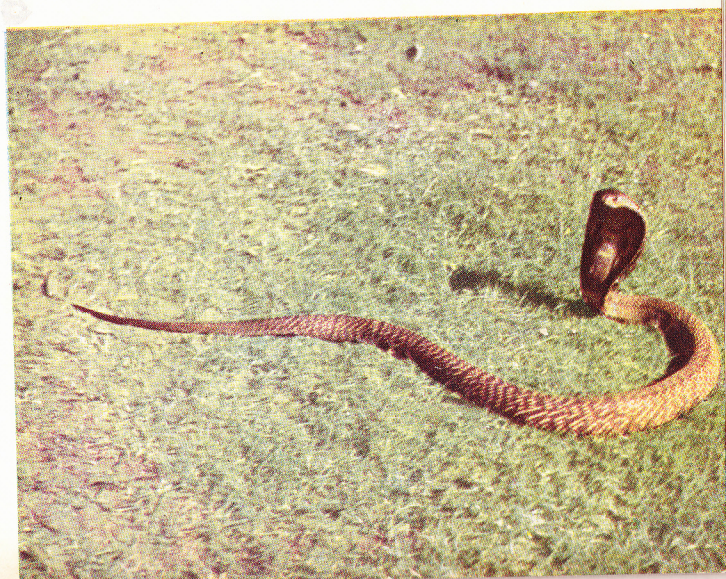


Fig. VIII. Whip Snake (*Dryophis nasutus*)
(Hidden among red flowers)

Fig. XIII. Cat Snake (*Boiga triagonata*)

This is a common snake of hilly regions. It is found in green vegetation in the open or near houses. It is sometimes mistaken for a pit viper. But the defined scales on the body and the black stripes clearly distinguish it from a viper. It feeds mainly on amphibians and may go in for small birds. Normally a very gentle snake, but when badly provoked expands the neck and even the body, like a Cobra, raises its head with the neck and tries to strike in desperation.

It is an oviparous non-poisonous snake.

BOIGA TRIGONATA

Cat Snake

Malayalam : *Churta*
Tamil : *Chingihahu*

Distribution: All over India.

Length: 825 mm. in male and 990 mm. in female.

Greyish brown snake with dark inverted V-shaped yellow-black bordered marks along the vertebral ridge. Belly whitish with black spots at the sides. Head with a large lung-shaped brown patch, edged with black, extending from frontal to parietals and their black arms extending upto neck. Yellowish brown stripe from eye to the end of jaw (*Figure 31*).

Maxillary teeth 8 to 10. Last few teeth enlarged and some grooved. Head distinct from neck, eyes large with a vertical pupil and yellow iris. Preocular 1, loreal 1, postocular 2, supralabials 9, 3rd, 4th and 5th touch the eye and infralabials 7 of which 3rd and 4th touch the posterior linguals. Nostrils between two nasals. Scales with apical pits and in 21 : 21 : 15 rows. It is a very vicious snake which assumes a provocative attitude with the least disturbance. It raises the head and keeping it in between coils of neck opens the mouth widely to strike tenaciously. It bites and also strangulates the victim with the pressure of the coils (*Figure 31*).

It feeds on frogs, sometimes mammals. An oviparous vicious snake that resembles a Cobra when raising its head. The two black streaks at the sides of the nape give the characteristic to aggravation. It is essentially a tree snake (*Figure XIII col.*).

DRYOPHIS NASUTUS

COMMON GREEN WHIP SNAKE

Bengali : *Lawudaga*
Gujarati : *Kankoti pankhu*
Marathi : *Sarptoli*
Tamil : *Kankoti pambu*

Distribution: All over India.
Length: 1,325 mm. in male and 1,940 mm. in female.

Parrot green all over with dorsal side full of faint black and white oblique lines which are well defined in the anterior region. There may be a yellow line followed by a faint blue line running along the sides. Ventrals pale green with a white or yellow streak laterally giving the impression of two lines at the sides. Mouth with a yellow tongue and a whitish blue throat (*Figure VIII col.*).

Maxillary teeth 12–15. Last two enlarged and grooved. Body very elongate. Hypophyses absent on the dorsal posterior vertebrae.

The head is elongate forming a pointed pale green tip in front of and above the mouth. This has a dorsal groove medially and is an elongation of the rostral shield. No loreals, internasal and prefrontals are in contact with labials. Preocular 1, postocular 2, supralabials 8, 5th touching the eye. The 3rd or 4th supralabial divided to form one or two presuboculars. Well defined eye with a horizontal pupil and a bright golden iris. These coupled with the forward position of the location of the eye, give this snake a very good vision. There is a well defined ridge on the eye formed of the supraocular shield.

This gentle snake inhabits high grasses, bushes or trees. It has been recovered from coconut trees, Banyan or Ficus tree tops. It remains coiled by its long thin tail, the head being held free from the coils. It has the habit of slowly swaying the head and coils in front and trying to take an aim at the eyes. Many people think that this is hypnotism. However, it does strike viciously and even puts a few coils round the victim. The food mainly consists of birds, lizards and some insects.

This snake is oviparous. It is a non-poisonous snake, but its bite has produced pain and swelling. The bite probably may be lethal

to birds and smaller life. While in captivity, the snake goes on striking against the glass in the cage and damaging the projection of its rostral shield. One therefore finds this snake in a cage with a bent in rostral shield projection. This snake has a better way of moving atop a tree from branch to branch than on ground. The colouration is in tune with natural surrounding and it is difficult many a time to spot this snake even though it may be very near one's face up a tree. Figure No. VIII of the coloured plate shows the colouration and camouflage.

PSAMMOPHIS LEITHI

SAND SNAKE

Distribution: Regions North of Gujarat, the Punjab, Kashmir, Rajasthan, Terai of U. P.
Length: 765 mm. in female, male probably smaller.

This light brown snake has four deep brown longitudinal stripes. These start from above the eyes reach upto loreals and extend by the side of vertebrals upto the tail. They have black spots at their outer edges. Two more stripes are present running from behind the eye to the end. These also have black spots. Both these stripes extend to about one scale in diameter. There is also a median faint brown stripe from frontal to rostral shield on the head. The ventral surface is pale yellow.

Maxillary teeth 11 to 12. No enlarged teeth. Supralabials 8, 4th and 5th touching the eye. Five infralabials in contact with the anterior genials. Two postocular, one preocular and one loreal. The preocular touching the 4th supralabial.

This timid snake often remains hiding or tries to hide. The eyes are small with round pupils. It feeds on frogs and lizards and is oviparous. It may enter house gardens in the rural areas but with the least disturbance it sleaks away.

CEREBERUS RHYNCHOPS

DOG-FACED WATER SNAKE

Marathi : *Pansarp*
Distribution: Coast and tidal rivers of India.
Length: 770 mm. in male, 1,100 mm. in female.

Bluish grey with well defined darker cross bars and spots. These are indistinct posteriorly and prominent anteriorly. Head with a dark post-ocular streak slightly passing through the eye. Lower surface pale yellow with black spots at the edges.

Head pear-shaped with a narrow snout. Nostrils directed anteriorly upwards and laterally. Eyes small with speckled iris and an elliptical pupil. Body stout and rough, keeled, slightly on costal side. Tail short, compressed at base and tapering to an obtuse point (*Figure 34*).

Nostril connected by a suture to the 1st labial. Preocular 1, postocular 2 and suboculars 2, supralabials 9, 5th and 6th below the eye, but not touching the eye. Four infralabials in contact with marginal scales. Scales on body striated or partly keeled.

These snakes are primarily met with in tidal rivers, creeks, and estuaries close to sea. They seem to anchor with their tail to vegetation and feed on fishes and eels. When the tide is out, one could still see them stranded. They are not good crawlers on land. Normally timid by nature, but when cornered they give out a disagreeable odour and bite viciously. They may also give out cloacal gland discharges. It is an oviparous snake.

ELASCHISTODON WESTERMANNI

INDIAN EGG-EATER

Distribution: Bengal, Bihar.
Length: 800 mm. in female, males not recorded.

These are olive coloured snakes with black spots. Head with black area from rostral to neck running above eye separating it from yellow margins. Stripes of black run from eye angles to the neck region. Eyes with a vertical pupil. Body covered by black spots interspersed with yellow. Vertebral column with yellow spots in between black irregular semi-cross streaks. Lips are yellow.

Maxilla rough with a few tiny teeth followed by two small grooved fangs at the posterior extremity.

No clear differentiation between head and neck. Nasal scale well enlarged. Preocular 1, loreal below preocular and touching the eye,

postoculars 2, supralabials 7, 3rd and 4th touching the eye. Scales on body in sixteen rows, the vertebral are slightly enlarged and hexagonal. It is for this reason that this snake may be mistaken for a krait, but the vertebral scales are not defined and the caudal scales here are paired.

Tail short and hypophyses absent in the posterior part of the vertebral column. Oviparous timid snakes supposed to feed on eggs, by swallowing them. The colouration makes it look fearful, but the snake is not ferocious or poisonous.

POISONOUS SNAKES

FAMILY ELAPIDAE

BUNGARUS CAERULEUS — THE COMMON KRAIT

Hindi : *Karayat*
Gujarati : *Konotaro*
Kannada : *Godinaser*
Marathi : *Maniyar*
Tamil : *Yannabarian*

Distribution: All over India.
Length: 1,500 mm. Males are larger.

This is a snake of plains, though some have been obtained at an altitude of 4,500 feet. Further, this snake is often confused with *Lycodon aulicus* and *Oligodon* species. Both these are non-poisonous snakes. There are distinct differences between these two snakes; whereas a Krait is distinctly steel blue in colour, the other two snakes are brownish. There is distinctly an enlarged chain of hexagonal scales on the dorsal side in a Krait, and the ventral scales beyond the annal to the tip of the tail are not divided. There is no enlarged vertebral hexagonal scale as well as complete ventrals beyond the vent in the other two snakes.

Head not distinct from neck. Head shields normal. No loreal. Postoculars 2, preocular 1, supralabials 7, 3rd and 4th touching the eye. Eyes moderate or small with round pupils. Scales smooth, polished and in 15–17 rows. Ventrals 194–234. Caudals 42–52. The dorsal most row strongly enlarged. In fact this

forms a hexagonal pattern all along the vertebral column (*Figure 38-1*). The ventral scales beyond the anal region in a single row (*Figure 37-5*). The colour is smooth, steel blue and often shining. There are rows of paired white stripes across the body. This colour and stripes vary in distribution. The stripes are not very distinct in the anterior region. Similarly some specimens in Maharashtra State showed mere white spots on the dorsal side without any cross bars. In some specimens even these spots were very faint. The younger specimens do not have a distinct steel blue colour and the stripes are more or less very close. At a later stage they may separate (*Figure IX col.*).

The eggs of this snake are laid between April-May, while they hatch in about 45 to 60 days. The newly emerged young ones, are hardly 150 to 200 mm. in length and grow at the rate of about 300 mm. per year. These snakes are nocturnal in habit and live in cracks in walls or in heaps of stones or bricks. There is a suspicion that they make a vocal noise specially in the morning.

This snake is poisonous. The venom is neurotoxic. There is not much pain at the site of the bite but in about an hour the patient feels sleepy and unless an antivenom is given in time, and if a lethal dose of venom has been injected, the patient may not survive. This snake not only eats mice but also other snakes too. In a snake farm this snake had eaten its fellow Krait.

BUNGARUS FASCIATUS—Banded Krait

Bengali : *Shankhini*
Hindi : *Ahiraj, Rajsanp*
Marathi : *Agimanyar*

Distribution: Assam, NEFA (Missimari and Chardwar), M.P., Bihar, Orissa, Tarai region of Uttar Pradesh.

Length: 1,700 mm. Males are longer.

Scales are in rows of 15, all along. The tail ends bluntly and is swollen at the tip. Ventrals 200–234. Caudals 23–39.

This is a beautiful snake having a jet black 50 mm. wide cross stripe alternating with a deep yellow stripe of the same size on the body. There is a black mark on the neck which is spread up

to the eyes. There are median black spots sometimes on the head. The dorsal portion of the body has a marked continuous projection like a ridge along with enlarged hexagonal central row of scales. The ventral row of scales beyond the vent are continuous (*Figure X col.*).

In Madhya Pradesh this snake is often seen after a few showers. It feeds on other snakes and villagers do not drive it from their farms.

BUNGARUS NIGER

The Black Krait

Hindi : *Kala Karayat*

Distribution: North Eastern Provinces, Assam, Darjeeling.

Length: 1,200 mm. Males are longer.

This snake is shining steel blue or black and is devoid of any white stripes. The ventral side is white with black spots. There are 15 rows of scales all over the body. A smaller species which is slightly less black has been recorded from Rangpur, Jalpaiguri, Darjeeling and Dibrugarh. It is mentioned as *Bungarus lividus*.

CALLOPHIS MELANURUS

Slender Coral Snake

Gujarati : *Ritugana*
Marathi : *Raat*

Distribution: Low hilly regions of Maharashtra, Nagpur district, Dharwar district of Mysore, Kerala, Coimbatore and Annamalai in Madras.

Length: 335 mm. Males are longer.

This snake is light brown above, and the centre of each scale is speckled with brown, forming a series of longitudinal lines all along the body. Head and neck black above with yellow spots. Tail with 2 black rings, one at base and the other at tip. The ventral surface is red in life (*Figure 39 a & b*).

Two or three minute teeth are present behind the poison fangs. One preocular in contact with nasal, 2 postocular, 1 + 1 temporal, 6 supralabials, 3rd and 4th touching the eye, 5th and 6th in contact with the temporal. 2 pairs of genials. 13 rows of scales. Ventrals 249–277.

This snake is poisonous. In Maharashtra it is believed that if this snake bites at night the patient will die before day-break. That is why it is called " Raat ". The venom is neurotoxic. Fortunately these snakes are not very common. They are oviparous.

CALLOPHIS NIGRESCENS

Distribution: Panchgani, Mahabaleshwar (Maharashtra), Nilgiri and Shevaroy Hills, Annamalai and Kerala.

Length: 1,140 mm. Males are longer.

Beddomme thinks that this snake grows upto 1,100 mm. or more and is thinner than the human index finger. Wall thinks that it feeds on other snakes and is an inhabitant of higher altitudes, over 300 feet. This snake has 30 rows of scales and its other characters are like those of *Callophis melanurus,* except that it may be pale reddish dorsally with 5 black stripes on the body, a vertebral, 2 lateral and 3 on the tail; the top of head black with light regular markings, a broad black bar on the nape, red ventrally, and the upper lip with black vertical marks.

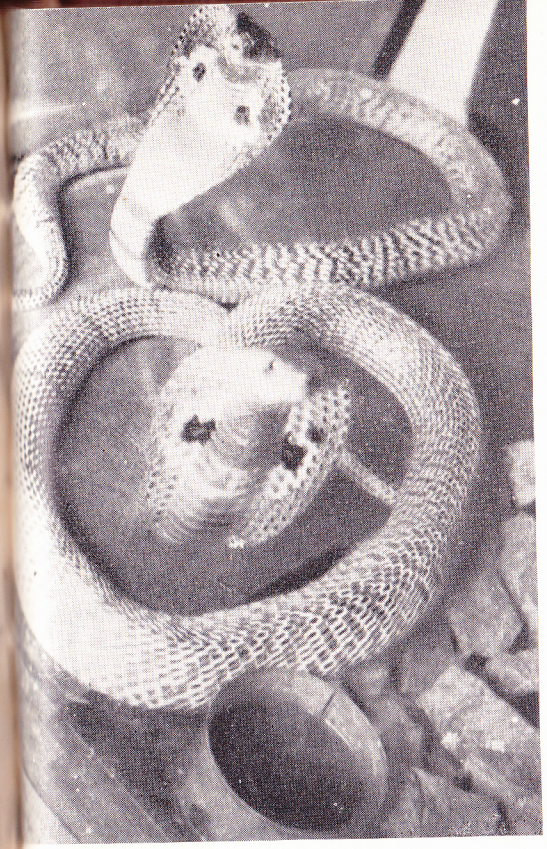
It is dark purplish brown with 5 black stripes edged with white, the white lines being continuous. Found in Nilgiris.

Blackish and greenish blue dorsally with 3–5 black stripes *not* edged with white reddish ventrally. This was collected in Panchgani and at Mahabaleshwar and Mangalvedha personally by me.

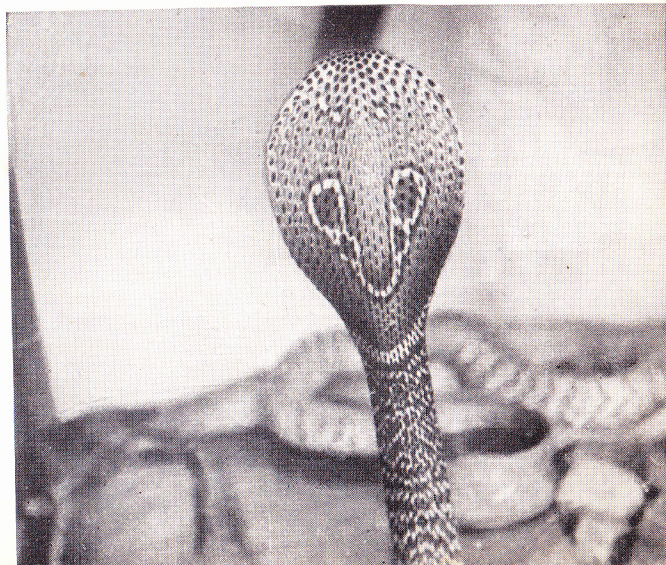
NAJA NAJA

COBRA

Hindi, Gujarati, Marathi: *Nag*
Bengali: *Gokhura*
Kannada: *Sarpammuikan*
Tamil: *Nala Pambo*

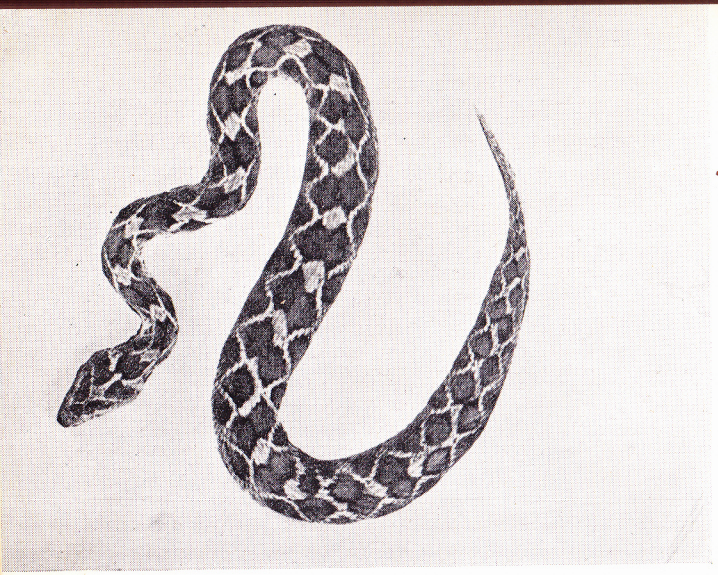


(*a*)



(*b*)

Fig. 45. Hood of Cobras.
(*a*) Ventral side of hood showing two black spots and three black bands.
(*b*) Dorsal side of the head showing the binocellate mark.



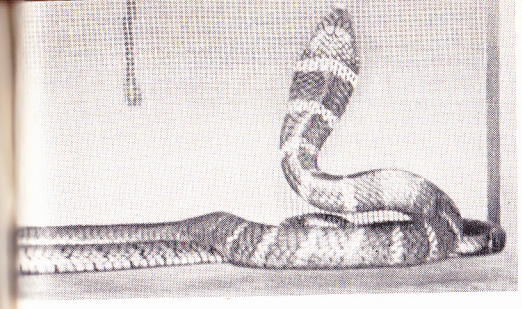
(*a*)

Fig. 46. *Echis carinatus.*

(*a*) Arrow head mark on the head.

(*b*) Camouflaged *Echis carinatus* on a rock.

(*b*)



(*a*)

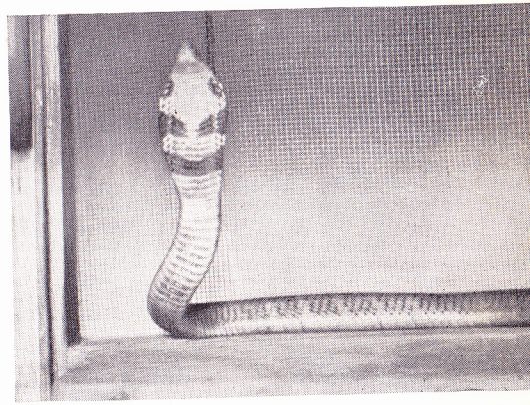
Fig. 47. King Cobra (*Naja hanna*).

(*a*) Hood shown dorsally to show "occipital shield" and yellow bands.

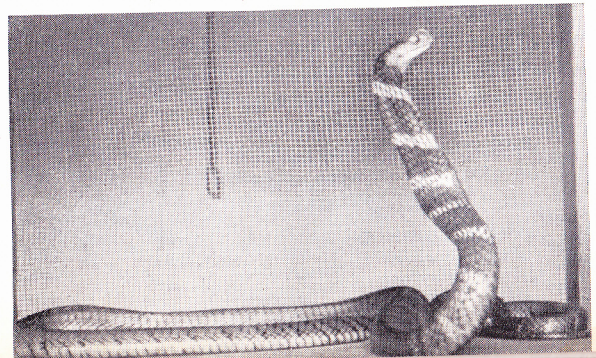
(*b*) Hood shown ventrally for two cross bands and a corner black spot.

(*c*) Lateral view to show the size of the hood.

(*b*)



(*c*)



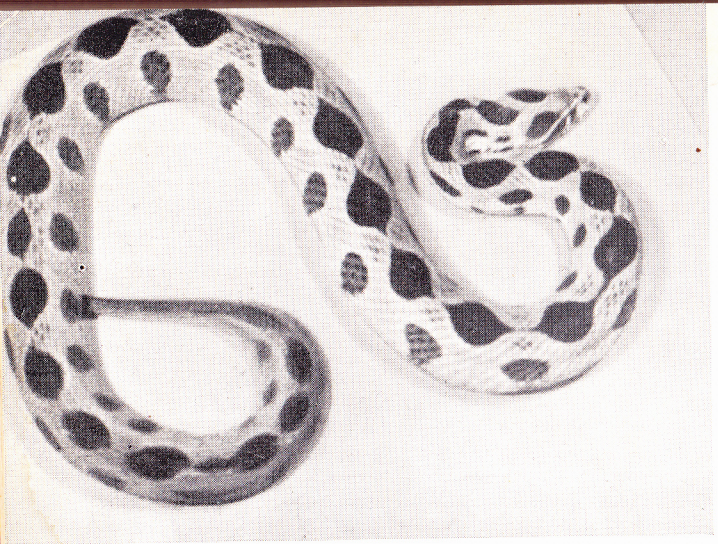


Fig. 49. Russell's viper (*Vipera russelli*).

Fig. 50. Cannibalism. Russell's viper eating another young one.

Distribution: All over India.

Length: Upto 1,800 mm. Males are longer.

In English, Cobra is a particular snake; but in Portuguese the word ' Cobra ' means any snake. It will therefore be desirable to call this snake " Nag " rather than Cobra.

The head of this snake is not very distinct from the neck. The neck region is dilatable, the ribs being elongate. The expansion of this region forms the hood which bears on the upper side a binocoellate mark which some people call a mark of spectacle or the figure of ten. There is a white band in the region where the hood touches the body region. In the Assam region this mark is monocoellate forming only a ring with a black mark in the centre. In the Rajasthan and Punjab areas the binocoellate mark is not complete in the lower region. It thus forms two lines only. There may be no mark at all. *Figure No. 44* shows the skins of different types of hood marks found in Indian Cobra snakes. The underside of the hood bears two dark round spots running to four scales surrounded by white lateral borders. There are three dark bands on the underside of the hood. Even if the mark on the upper side is absent the underside invariably bears the three transverse bands which is quite a distinctive feature of this snake (*Figure 45*). Similarly this snake is brown or dark in colour. The brown ones are called " Gehuwa " and the dark ones "Domi" in the Hindi speaking areas. Sometimes one comes across a golden yellow colour in this snake, particularly before monsoon. This colour changes to brown when the snake is exposed to sunlight. The golden colour is due to winter hibernation when the snake remains in seclusion away from light. We often see such colouration also in frogs which are seen absolutely yellow at the first onset of monsoon, but turn olive and deep brown after a few hours of exposure to light. In the lower Rajasthan, an albino variety of Cobra is occasionally met with. There is a faint impression of marking on the hood and faint dark bands on the underside of the hood of this Cobra. The local people call it " Basuki nag ". There is nothing special about it, except the albinism.

In the Bassein region of Bombay, the Nag bears some V-shaped cross-bars on the body. The Assam monocoellate Cobra also bears

such cross-bars (*Figure 44*). Collections from a number of regions in India show such faint markings in this snake.

Apart from the above distinctive features, this snake could further be identified by the smooth oblique scales on the body, which are 25–35 on the neck, 21–25 in the mid body and 15–17 at vent. The caudal scales are paired. The ventral scales range from 176 to 200. There are variations in these scales and the snake is further classified accordingly.

Maxillary bone extends beyond palatine. Poison fangs are followed by 1–3 small teeth. The neck is dilatable ; the anterior ribs being elongate. Nostrils are between an anterior and posterior nasal scale. Loreal is absent. Scales on body are disposed of obliquely. Subcaudals are paired. Eyes are round, equal in diameter to its distance from mouth. Nostrils large, vertically elliptic, frontal larger than broad with a truncate anterior margin. Internasals, as long as or a little shorter than prefrontal, preocular usually in contact with the internasal.

Some head scales form a typical identifying mark for this snake. The frontal shield is truncated (*Figure 36-IV*). There are three post-ocular scales. The third supralabial is big and touches the nasal and the eye. There is a small triangular scale edged in between the fourth and fifth infralabial and there are three black stripes on the underside of the hood extending from 10 to 17 ventrals. There are two black spots extending from fourth to sixth scale size between 15 to 30 ventral scales on the underside of the hood.

This snake is common all over India. It is normally seen in the open in the evening or early morning. In old thatched roofed houses, it has been seen under the roof where it may have gone in search of its prey. In very old buildings, it has been noticed to remain in crevices, presumably in the cool dark places where rats are also available. It may be noted here that the presence of this snake in and near houses is an indication that it has come for its food, the rat, frogs or birds. If these are kept away, this snake may not come to houses.

This snake is worshipped. During *Nagpanchami* day, it is taken from house to house, offered milk and money collected. Whenever a person is bitten by a snake, it is often taken for granted that it

must be a Cobra. The local charmers then gather in a temple and the victim supposed to be possessed by the Cobra is made to lie down. The patient froths from the mouth and is often given neem leaves or chillies to chew and his face sprinkled with cold water. However, it is significant to note that in all temples of the villages a spell is cast only for Cobra bite. We have not come across a charm or mantra to cure a Krait or a Russell's viper bite. Many old buildings are believed to be inhabited by a Cobra which is " guarding the wealth ". Under pipal trees are kept images resembling a Cobra hood and many a lady circumambulates such trees for fertility (*Figure 6*).

There is no truth in the belief that a Cobra has a Jewel on its head (*Figure 24*). There is hardly any evidence to show that a Cobra takes revenge even after a lapse of some time or that a Cobra is allured by soft music (*Figure 2*) or an old Cobra has white hairs or moustaches (*Figure 15*). These and allied points have already been discussed in the first two chapters. This snake sheds skin more frequently in summer months. The younger snakes shed it quicker. It normally raises the hood about $2\frac{1}{2}$ feet from the ground and the striking range comes to a radius of about the same length. If one kept still beyond this range, it is quite likely that the snake will retreat. But if one moved or ran, it is also likely that the snake will give chase for some distance. Due to fright the speed of the runner is reduced and accidents do happen. The speed of a Cobra is far less than that of men (*Figure VII a, b & c col.*).

These snakes mate during the rainy season. The mating is done lying down. One often observes two Cobras coiled up above ground and swaying. It has been seen that these are both males and the phenomenon is probably a fight between the two. The egg laying takes place about nine to ten months after mating. This happens in the month of April. We have seen 56 eggs laid in three days. The female sits on the eggs which are mixed with the soil and dry vegetation. The female does not leave the eggs alone. The eggs start hatching after 58 days. The young ones have a properly formed hood, and strike in the same fashion as the adult. There is venom in the glands of the young snakes, and this could be lethal. The shedding of the skin is done first on the 2nd

day, then 7th, and later on 21st to 30th days. The shedding is less frequent after this. The young snakes probably do not feed for a few days. Later, after about a month, they have been seen to go in for young frogs, young mice and young lizards. On birth the snake is 8″ to 10″, after one year it is 2′ 6″ and by four years it is about 5 feet. It probably matures after three years.

The poison of this snake is primarily neurotoxic. There is less pain, slight swelling, irritation and death is due to respiratory failure.

If a sufficient amount of venom has been injected by this snake, the only remedy is the antivenin. A few *mantras*, herbs and charmers have actually been given trial on laboratory animals, but these could not save the animals.

NAJA HANNAH

KING COBRA (HAMADYARD)

Hindi: *Rajnag* or *Nagraj*
Gujarati: } *Rajsanp*
Marathi: }

Distribution: Assam, Nilgiris, Londha region of Karwar, at higher altitudes.

Length: 4,500 to 5,400 mm. Males are longer.

This snake is found in fairly dense forests particularly at a higher altitude. It grows upto 18 feet. In young age, the snake is olive or faint black with thick faint yellow chevron shaped stripes all over the body. In older specimens, the colouration of the stripes becomes faint. On the head are four chevron shaped bars distinctly seen in the younger snakes. In fact the older specimens look just faint black with very faint stripes or no stripes at all (*Figure 47*). The hood is less wide, but longer than that of a Cobra. The scales on the neck are only 17–19, the ventral scales being 240–254. The difference between this snake and Cobra consists of the following :—

(*i*) Frontal is not truncated,
(*ii*) The enlarged supralabial just touches the nasal and eye,
(*iii*) There is no triangular scale wedged in between fourth and fifth infralabials,

(*iv*) Pair of occipital scales (*Figure 36*) are present beyond parietal and,
(*v*) Few caudal scales near the anus are unpaired while the remaining upto the tail end are paired.

This snake usually feeds on other snakes which include both poisonous and non-poisonous ones. However, we have observed that a King Cobra whose fangs had been pulled away, ate a rat-snake by chewing it and probably trying to force the venom into the lacerations. As snakes are found in secluded places and these comprise its main diets, it has to keep any disturbance away from such area. It is for this reason probably that this snake tries to attack any one with least provocation. It raises its head often upto 3 feet in height and stands in a very aggressive manner. The mating may take place in the rainy months, but the eggs are laid in April. In fact the snake makes a nest of bamboo leaves and twigs and lays eggs in the lower compartment. A nest was laid for this snake in the New York Zoo cage and the picture of this taken by Dr. Oliver, Director of the Zoo is given here (*Figure 48*). Here the snake is seen emerging from the egg.

Considering the size of the snake, the amount of venom given is much more than that by a Cobra. It is probably this quantity of the venom that may account for its heavy lethality. However, tests done at the Haffkine Institute have shown that the antivenin that works against a Cobra venom has been able to neutralise King Cobra venom also. As the snake is a rare animal, the number of deaths due to it may also be low.

FAMILY: HYDROPHIIDAE

HYDROPHIS CAERULESCENS

SEA-SNAKE

Hindi: } *Samudra sarp*
Gujarati: }
Marathi: }

Distribution: All along the coasts of Peninsular India.

Length: 820 mm. in male, 740 mm. in female.

The snakes are faint, sky blue above and white on the ventral side. There are about 50–60 broad dark cross bands dorsally which taper down the ventral sides.

These markings diminish as age advances. The head in the adults is deep grey, while in the young it is black with a yellowish crescent mark which may be absent in older specimens.

The head shields are broken up. There is no loreal shield. Behind the poison fangs are 14–18 maxillary teeth. Preocular 1, postoculars 2, supralabials 7–8, of which 3rd and 4th touch the eye and the 2nd in contact with prefrontals. Four infralabials in contact with genials. 31–43 scales on the neck.

The body is compressed posteriorly. The tail becoming flat, is shaped like a paddle. The body is rounded and the ventral scales are more or less reduced. Neural spines are developed in the caudal region and hypophyses are well developed throughout the vertebral column.

These snakes live in water and are caught in fishermen's nets or due to ebb tide are left behind on the sea shores. They are very good swimmers, but due to the absence of defined ventral scales, their movement on land is very slow. They disappear in water as soon as disturbed.

These snakes feed on fishes, eels and some other sea food. They are oviparous.

The poison of these snakes is neurotoxic and many a fisherman have complained of bites and effects of the poison. The only redeeming feature about their danger is that the bite takes place in sea where the venom gets diluted and as the fangs of these snakes are a bit behind, the snake therefore does not always get a good grip to bite and inject the poison.

They are really a source of danger in the gulf of Penang where an antivenin has been now developed against their bites.

FAMILY: VIPERIDAE

The characteristic of this family lies in the fact that the fangs reach a high level of perfection. They have big curved fangs, erectile and have a duct inside that opens at the tip of the fangs on the outside. The fangs are covered by a sheath and lie in repose

at the side of the jaw (*Figure 16*). There are two fangs in position with auxilliary buds of their base. When one fang is broken, the bud takes its place. The erection of the fangs is brought about by the palato-maxillary arch in which the maxilla revolves like a hinge on the anterior end of the prefrontal (*Figure 19*). The poison causes swelling and intense pain at the site of bite and the other symptoms are discussed in Chapter 3. To this family belong the vipers and pit vipers. All these snakes are viviparous, *i.e.*, lay young ones directly and not eggs.

VIPERA RUSSELLI

RUSSELL'S VIPER

Hindi:	*Kander*
Bengali:	*Chandrabora*
Gujarati:	*Chital*
Kannada:	*Baliwadak-hawu, Mandalatha-hawu*
Malayalam:	*Ruthram mandli*
Marathi:	*Ghonas*
Tamil:	*Mandli*

Distribution: All over India even at some altitudes.

Length: 1,600 mm. in female; males are slightly longer.

This is quite a common poisonous snake in India which is often 150 mm. thick and is heard to hiss loudly and continuously. It is brown with deep elliptical patches that run in three rows. A maximum of 37 dorsal (vertebral), 27 lateral patches were observed along with about 84 black spots on the ventrals (*Figure 49*).

In newly born specimens the maximum spots are 25 dorsal and 22 lateral. The length of such snakes was about 240 mm. and weight about 14·3 gm. The length of adult female was 1,100 mm., weighing 1,967 gm.; the males being less bulky. There is a great variation in these patches in colouration as well as form. While normally it is brown, the South Indian vipers have a white border edged with black spots and even the central region forming an island. Some snakes caught in the Bombay region during the breeding season show a faint amber colour with faint brown spots. These are males

and this colouration disappears after the breeding season. The patches are complete and separate anteriorly while the posterior ones seem to merge at the ends particularly in the dorsal region and more so in the younger specimens. The lateral patches do not have a defined elliptical shape, but look like a semi-circular tree top with a stem going down towards the ventral. Apart from these there are black patches at the sides and a pair of deep brown spots on each ventral scale. The posterior of each scale below the head bears a black spot and the head bears a black patch below as well as behind the eye and beyond the parietal region upto the neck (*Figure XI col.*).

The head is triangular and the head scales on top are very small, imbricate and keeled. In fact all dorsal scales are keeled, except in the outer rows.

The snout is angulate and the nasal opening is quite prominent. The eyes have a white border with golden iris and an elliptical pupil. Supralabials 10–12, 4th is the largest and it does not touch the eye. A number of small scales run round the eye and about three rows of them separate the eye and the 4th supralabial.

This snake is found in rocky and bushy regions where the colouration on the skin is in keeping with the surroundings. The snake has been seen to go up the bushes and small trees. It remains coiled with the head in the centre of the coil. With least disturbance, the tongue quivers, the head is raised, the body swells rhythmically and the snake hisses loudly and continuously. This hiss differs from that of a Cobra in the sense that the Cobra noise is intermittent and of a short duration, while in a Russell's viper, it is continuous and loud. It can strike even from behind. It hurls itself at the victim and the big fangs which are nearly 10 mm. in length are pressed into the wound. Often times the venom is sprayed while the snake opens the mouth, and withdraws the sheath before it hurls itself for biting.

The chief food of this snake comprises small mammals like rats and mice. Sometimes lizards and birds are also taken.

Mating has been observed in a snake farm in July–August. The snake is viviparous and young ones were born in June. One

Fig. IX. Common Krait (*Bungarus caeruleus*)

Fig. X. Banded Krait (*Bungarus fasciatus*)

Fig. XI. Russell's Viper (*Vipera russelli*)

Fig. XII. Green Pit Viper (*Trimeresurus gramineus*)
(It is about to strike)

female gave 97 young ones in three days. On birth they ranged from 110 to 130 mm. and weighed from 14·5 gm. to 16 gm. The spots were rather confluent. The skin is cast on the first day, then on the third, seventh and later after a month. The young ones try to feed after about 21 days. They are as poisonous in young age as adults, except that the amount of venom given is rather small.

In captivity these snakes have lived for about four years. The major illness in them was the infection of the mouth, swelling of the throat and head and the death was after the pus formation in the area. The bite of this snake in the laboratory gave rise to a swelling and pain. The swelling continued for some days and the site of bite darkened (*Figure 22*). The patient survived with no other complications after a month of hospitalisation.

ECHIS CARINATUS

Side Winder or Saw Scaled Viper

Hindi: *Afai*
Bengali: *Bankoraj*
Kannada: *Kallu hawu*
Kashmiri: *Gunas*
Marathi: *Phoorsa*
Punjabi: *Afai*
Tamil: *Ratapambo Birianpankhu*

Distribution: Nearly all over India.

Length: 550 mm. in both male and female.

This small poisonous snake (*Figure 46*) has a head that is triangular and bears a typical white arrow mark on a brown background. The body is greyish brown with a series of pale marks forming a curve over the body. These pale spots numbering from 25–31, are edged with dark spots all over the body. The under surface is white with black spots at the two ends of the scales. It is often met with in a double curved position with head in the centre and moving as a side winder and making a sawing noise by rubbing the scales.

The scales on the head are semi-circular and tiny as well as covering each other. They are strongly keeled. Behind the neck

and at the sides these keeled scales have serrations (*Figure 14*). These are rubbed to give the noise one hears when the snake is in movement. Supraoculars are very narrow and often broken up. A ring of small scales round the big eyes which has an elliptical pupil. Supralabials 10–12; two rows of small scales intervene between them and the eye. Caudal scales 24–25 in a single row.

In the Ratnagiri district of Maharashtra these snakes were collected in numbers. In 1876 the number of deaths due to snake bite in this district was 123, while an amount of Rs. 4,417 was spent towards collecting and destroying in one season 1,40,828 of these snakes. Even now they are collected under the stones and in the red soil in Deogad taluq. We arrange to gather about 5,000 of these snakes during monsoons, within a period of three months. A large number of these snakes are young. It is observed that these viviparous snakes lay the young after the onset of rains in the month of July.

A large number of Echis snakes dissected have shown that the food of the snake consists of young frogs, lizards, snakes, scorpions and a large number of insects. In fact, the major part of the food content consisted of the bodies of forficulid insects. These snakes have been reared on this diet. They are often seen on bare rocks even on hot days. In the deserts of Rajasthan these snakes have been observed moving in the sands at night and probably hiding during the very hot period of the day. On being disturbed, they strike, rising upto a height of about eight inches from the ground. Even while moving, the head is often flipped for a strike. Being small and lying under stones and in soil and also because of the colouration being akin to surroundings, the people get bitten before they are aware of the presence of these snakes.

These are pretty poisonous snakes, but the amount of venom given at a time is not sufficiently lethal to a man. There are always complications after a bite. There is swelling, oozing and within 24 to 36 hours the man starts bleeding from gums, kidneys, nose etc. The death is due to these complications which kill a man after a number of days. This is unlike the Cobra and Krait bite when the death is more or less on the same day. *Dipsas triagonata* is often mistaken for Echis. *Psammophis species* preys on this snake.

ANCISTRODON HIMALAYANUS

HIMALAYAN PIT VIPER

Kashmiri : *Pohur*

Distribution: Hilly region in the North and the Eastern part of India.

Length: 600 mm. in male, the same length in female.

Bluish brown dorsally with dark brown mottled or black spots appearing like cross-bars with whitish interspaces all along the body. These bars are more prominent anteriorly in the vertebral region. One stripe appears from the eye to the temporal and even the neck region on either side. Mouth is grey with black spots. Ventral side brown with black and white spots.

The upper lip is slightly raised medially in the rostral region. Nasals divided into two, supralabials 5–7, third and fourth enlarged but not touching the eye. A small scale intervenes between supralabial and the eye. Postoculars two, the last greatly enlarged. Supraocular enlarged sideways to form a shield over the eye. Preocular three. Pit in loreal in between preoculars. Eye big, iris speckled in gold and the pupil is vertical. Scales strongly keeled.

This snake is common in the Kashmir Region and is found even at an altitude of 12,000 feet. There is one recovered from even 16,000 ft. In Assam, NEFA, Sikkim, and Khasi Hills this snake is found at higher altitudes. In Kashmir it is said to be responsible for death in cattle and sheep.

It is quite a timid snake remaining hidden under stones and with the least noise or provocation it rushes back to shelter. Even when handled it is not prone to bite. It is no doubt a poisonous snake, which has well formed erectile fangs under sheath. The poison is probably haemotoxic.

It is viviparous.

TRIMERESURUS GRAMINEUS

BAMBOO PIT VIPER

Hindi and Marathi : *Haranag*
Gujarati : *Nagubiyo*

Distribution: Common in regions of thick bamboo growth in Peninsular India.

Length: 750 mm. both in males and females.

This verdant green snake (*Figure XII col.*) has a triangular head and three yellowish white longitudinal lines on the body ; one vertical and two lateral. Prehensile tail yellowish or reddish mottled with dark hues, greyish, with some grey spots ventrally. Head with blackish spots on imbricate scales and a speckled line from eye to neck. Eyes with a golden iris and a black vertical pupil.

This is a snake of low vegetation, normally met with in tropical and subtropical regions. It prefers the bamboo vegetation or grass on which it is often seen reclining during daytime. The colour harmonises with the surroundings. It is sluggish, but when roused is capable of hissing and snapping at the victim.

Supraoculars small, Postoculars–3, supralabials 11 of which none touches the eye though the third is enlarged. The pit is in the region near the first and second supralabial. This is a variously interpreted (*Figure 26*) organ ; it is thought to be a chemoreceptor to judge the temperature variations or probably to inform the snake about the approach of the victim.

The food of this snake consists of small mammals, lizards or birds. It strikes the victim and holds it till it is dead. This is a viviparous poisonous snake, whose venom is probably vasotoxic.

Birds Specimens
on 28/2/68

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